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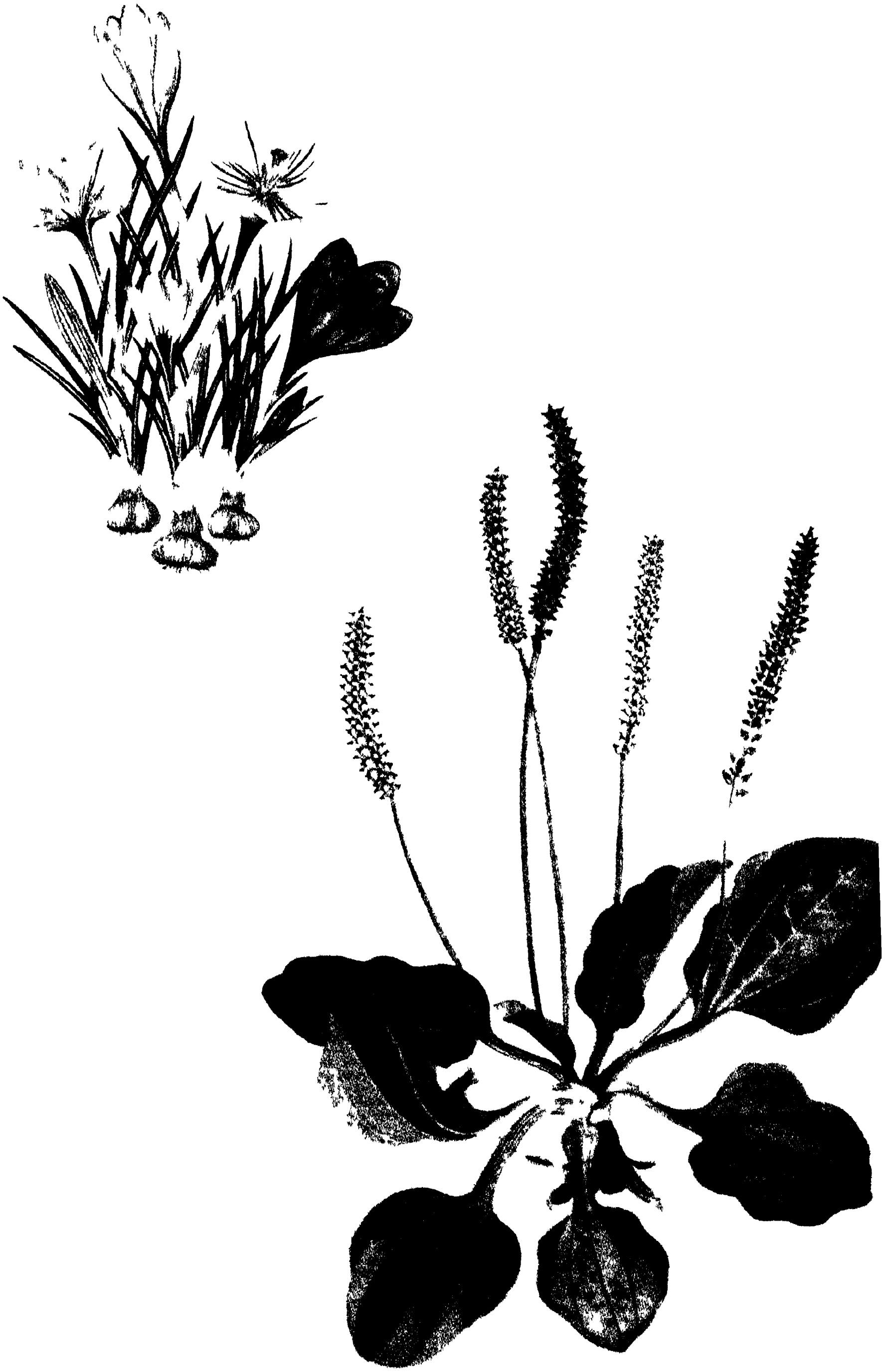
THE TEACHERS' GUIDE



MEMORY DRAWING OF PLANTS

Work done by Children of 15

THE TEACHERS' GUIDE

A Practical Treatise written by Specialists

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GEORGE COLLAR, B.Sc., B.A.

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ELEMENTARY SCIENCE

BY

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ELEMENTARY SCIENCE

CHAPTER I

Introductory

In making up the syllabus for an elementary science course the particular needs of the pupil must be borne in mind, for the requirements of a scholar who is going either to a technical college or a university are obviously different from those of pupils who leave school at 15 or 16.

Another consideration is that in the teaching of science a teacher finds himself hampered by the lack of the necessary apparatus, though this difficulty may be partially overcome by the making of apparatus by the pupils themselves. Useful hints on this point will be given. Most schools provide a course of training in woodwork, and courses in metalwork are not uncommon.

A good teacher seeks to guide his pupils to find out the truth for themselves, to acquire their knowledge as far as possible by direct experiment, teaching them to observe accurately and draw correct inferences from what they see.

Where the experiments are beyond the powers of the pupils and have to be carried out by the teacher, the pupils should feel that they are active partners in the work. The teacher should ask them *what* should be done and *why* it should be done, and what will be the result. Generally the experiment should end with the teacher asking the class what the experiment has taught them.

Sometimes an experiment is worked with the object of finding out what will happen, sometimes the teacher asserts that a certain result will follow. The teacher should work the experiment beforehand, as essential details are often omitted in the textbooks. Thus the books state that the affinity of chlorine for hydrogen is so strong that if a piece of blotting paper moistened with turpentine be plunged into a bell-jar full of chlorine it will burst into flame and soot will be deposited. But if the turpentine is cold nothing happens except a discoloration of the paper. *The turpentine should be warmed before being poured on to the paper.*

Again some matches are impregnated with chemicals so that they shall not glow after being blown out. A teacher relying on such a match to illustrate the properties of oxygen is asking for a failure.

Allowances often have to be made for such conditions as friction, which cannot be altogether eliminated, but which should be reduced as far as possible, and the margin of probable error should be forecast.

Strict discipline is essential in the science room, as serious damage to fittings and apparatus, and bodily harm to pupils, may result from " larking " or carelessness.

Cleanliness and tidiness can be inculcated in the science lesson more effectively than in any other part of the curriculum. A headmaster once said that, apart from the knowledge the boys acquired, the training in order and neatness was an ample return for the time devoted to science. We might add that order developed in connexion with the use of material apparatus leads naturally to ordered thought and life.

Science is a study which is continually advancing, and what may pass for full and complete knowledge at one period may prove to be not only incomplete but actually untrue at another. While there are plenty of elementary subjects to supply materials for school courses, the teacher should endeavour to keep himself informed of every important advance in knowledge. He should not only carefully read the scientific articles appearing in the magazines, but should attend lectures, and if he meets with any apparent difficulties he should not rest till he has overcome them. There is generally a Technical Institute within reach, and by attending some of the classes there he will undoubtedly find something to help him in his classroom work.

He should procure for his own private bookshelf some of the books that are regarded as " scientific classics ", and some which treat of the latest scientific developments, and as far as he can, see that such works are added to the " Teachers' Library " at the school. There should also be a good proportion of books dealing with scientific subjects in a simple manner in the " Scholars' Library ".

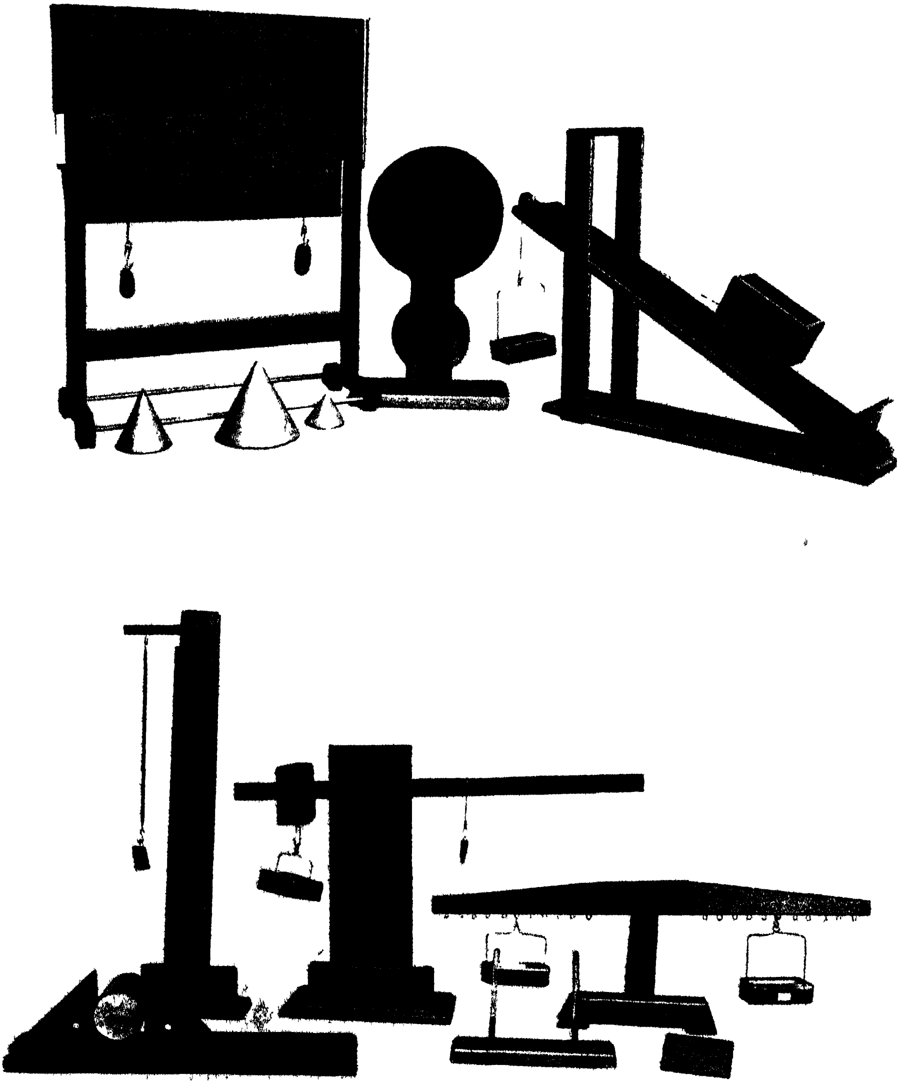
CHAPTER II

Measurements

Apparatus

Calipers, 3½ in. (inside and outside).
Vernier, 30 cm.
Micrometer screw gauge.
1 balance for teacher.
1 balance for every 4 or 6 pupils.

Lord Kelvin once remarked that you could not consider that you knew anything about a thing unless you could *measure* it, but if you could measure it you did know *something* about it. The teacher will see the



SCIENCE APPARATUS MADE IN THE HANDWORK ROOM

importance of training his pupils to take careful measurements. That this is not such an easy matter as it seems may be shown by telling each boy in the class to measure the exact length of the classroom with a foot rule and to compare the results. Abundant exercises in the measurement of lengths should be given and the results expressed in both metric and British units. The pupil should be taught the use of some of the more common means of making accurate measurements, verniers, calipers, &c., and should construct a vernier for himself from two strips of thin card or thick paper, one about five or six inches long and divided into tenths of an inch, the other about $1\frac{1}{2}$ in. and having in the middle of one edge a length of $\frac{9}{10}$ in. divided into ten equal parts. On testing the length of an object with the longer strip it will be found to be, say, a little over $3\frac{7}{10}$ in. long. Now on applying the shorter strip to the end of the object, it will be found that one mark on this, say the third, corresponds with one of the decimal marks on the long strip. This shows that the object exceeds $3\frac{7}{10}$ in. by $\frac{3}{100}$ of an inch.

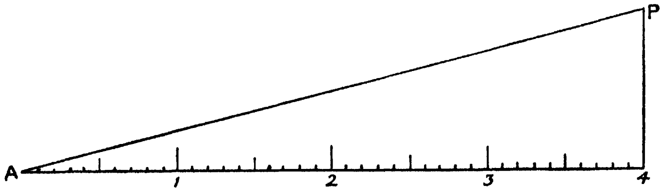


Fig. 1.—Measuring the Bore of a Pipe

The length of the object is then 3·73 in. Each division on the vernier is $\frac{1}{100}$ of an inch less than the tenths marked on the large scale. It follows that as three such divisions are necessary to secure coincidence, the end of the object must be $\frac{3}{100}$ of an inch beyond the $\frac{7}{10}$ shown on the scale. The principle of the micrometer screw is very easily explained.

The pupils can be set to discover the method of measuring the diameter of a ball or an egg by placing it on a table between two upright set squares and measuring the distance between the two squares.

This will lead up to practice in the use of callipers.

A strip of cardboard cut as in fig. 1 can be used to measure the bore of a pipe, &c. The width of the strip at any point P will always be a quarter of the distance of that point from A.

Similar strips can be cut in which the width at any point may be one-eighth, one-tenth, or any other fraction of the distance from the end of the strip, by cutting them so that the width at the wide end is one-eighth, one-tenth, &c., of the total length of the strip.

The pupil's ideas of lengths and distances will be made the more real if he is first asked to estimate them and then set to check his estimate by actual measurement.

The area of the simpler plane figures is easily found by measuring the length and breadth, and multiplying the *numbers* of units in these dimensions, but the pupil must be taught to avoid the expression "*Multiply the length by the breadth*", though older students may use the term quite legitimately.

The volumes of regular solids may also be calculated after measuring the three dimensions. The liquids are generally measured by means of vessels of standard size.

Some inexpensive forms of chemical balance should be provided and the pupils exercised in their use, including the use of the "rider", the principle of which will be explained in connexion with the lever.

CHAPTER III

Matter and Force

APPARATUS

3 spring balances (to 12 lb.).
3 aluminium pulleys to clamp to blackboard.

Matter

In science this word is used to denote anything which occupies space and offers resistance to the action of a force. It is better to give the pupils a clear idea of the nature of matter by giving numerous examples to be classified into matter and non-matter than to insist on a precise definition.

It will be next pointed out that matter exists in three conditions, namely, solids, liquids, gases. Lists of these should be drawn up. Further, on considering the properties of solids it will be seen that, however much variation there is between them in other properties, they all have more or less *cohesion*, which enables them to keep their form. *Liquids* on the other hand only hold together when kept in some vessel the form of which they themselves have to adopt. In a gas the particles seem to repel one another so that unless they are completely enclosed they will expand indefinitely. Most matter known to us can exist in any one of these states. Different forms vary in the speed of transition. Ice if heated continuously *liquefies* into water and then evaporates or becomes steam. Substances like iodine *sublime*, i.e. they pass directly from the solid to the gaseous state.

Elementary Ideas of Force

Force is sometimes defined as that which causes or tends to cause an alteration in the state of rest or motion of a body. It seems generally to be associated with pushing or pulling of some kind.

EXAMPLES: 1. *Rest changed to motion.*—A bullet was at rest in a gun; on pulling the trigger the explosion of the powder exerted a *force* on the bullet which caused it to move forward.

2. *Motion changed to rest.*—A cricket ball is moving through the air;

a fielder catches it and brings it to rest in his hands. To do this he exerts a force.

3. *Changing the direction of the motion.*—A batsman strikes a ball and sends it either forward or to one side.

4. *Tendency to change.*—A boy presses against a door which is locked. The door does not change its " state of rest or motion ", but it *tends* to change. The change is resisted by the lock and doorpost.

The principal conditions we require to know when dealing with any force are (1) its magnitude, (2) its direction, and (3) the point at which it acts. It follows from this that a force may conveniently be represented by a straight line, which can be drawn in any required direction and through any given point, the length of the line representing the magnitude of the force.

Many simple but instructive experiments may be worked with the help of a few easy-running pulleys and some weights, and one or two spring balances.

1. *Equal forces acting on a point in opposite directions in the same straight line are in equilibrium.* This may be taken practically as an axiom, but numerous examples should be shown.

2. The converse of this is also true, viz.: *If forces acting in opposite directions in the same straight line are in equilibrium, the forces are equal.* This naturally leads up to the consideration of the sum, or difference, of a number of forces acting on a point in a straight line, e.g. 4 lb. + 3 lb. = 7 lb.

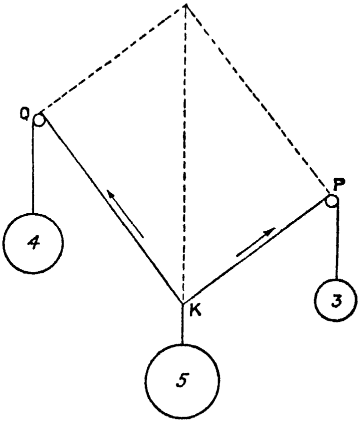


Fig. 2 —Parallel Forces

With the help of a light rod it may be shown that the resultant of two parallel forces in the same direction is the sum of the forces, and acts in a parallel direction at a point of which the distance from the points of application of the two forces is inversely proportional to the forces. This in reality is what is often called the *Principle of the Lever.*

The composition and resolution of forces that are not parallel can be illustrated with the help of weights and pulleys. Arrange weights of 3, 4, and 5 lb. with flexible cords passing over the pulleys as shown in fig. 2. The weight 3 causes a pull, or tension in the cord passing over the pulley P and exerts a force of 3 lb. on the knot K in the direction KP. Similarly the weight 4 exerts a force of 4 lb. on the knot in the direction KQ. Lastly the weight 5 exerts a force of 5 lb. vertically downward. If the cords move freely over the pulleys the weights will come to rest and remain in equilibrium in the position shown.

From KP cut off KA three inches in length, and from KQ cut off KB four inches in length, and complete the parallelogram KACB. On drawing and measuring the diagonal KC its length will be found to be five inches, which is the length of the line that would represent a force equal to and opposite to the force of 5 lb. exerted on K by the weight 5. Further experiments of the same kind but with different weights will suffice to establish the principle of the *Parallelogram of Forces.*

If two forces acting on a point are represented in magnitude and direction by two straight lines, their resultant will be represented by the diagonal of the parallelogram of which these two lines are two adjacent sides.

Conversely if a force can be represented by a line forming the diagonal of a parallelogram, it may be replaced by forces whose magnitude and direction will be represented by two sides originating in the same point as the diagonal.

Force may be communicated to bodies either by pressure or pushing force, or by tension or pulling, and the parallelogram of forces is true in each case.

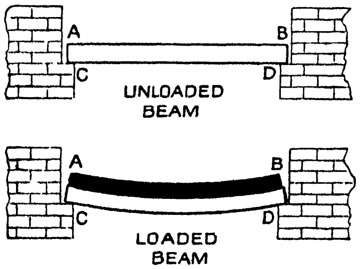


Fig 3.—Loaded and Unloaded Beam

Bodies differ from one another to a remarkable degree in their power to resist pressures and tensions. Cast iron will resist a very great pressure, but offers much less resistance to tension. It takes about 5½ times as much force to break an iron bar by *crushing* as would be necessary to *tear* it apart. On the other hand wrought iron offers about twice the resistance to tearing that it does to crushing. Steel is greatly superior to both forms of iron in both respects. Its resistance to tearing is about 2½ times that of wrought iron, and its resistance to crushing about twice that of cast-iron. In any construction therefore it is very important to use in each part the material which is best suited to stand the strains which occur in those parts. Take as illustration a step-ladder.

Consider a simple span roof, where we see that the rafters which take the thrust due to the weight of the tiles or slates are kept from pushing the walls outwards by a tie rod, and this is often a simple iron bar, or even pipe, which is sufficient to take the tension. The pupils should be taught to look out for examples of this sort, and problems given them to solve. In this way a gate is formed by a rectangular frame of bars. How will it tend to drop out of shape? How could you prevent this (*a*) by a chain, (*b*) by a rigid bar of wood? How will the brace of a gate indicate on which side the hinges are?

Very often a wooden beam is used to support the wall over a shop front or similar opening. In fig. 3 let the rectangle ABDC represent the beam which when loaded tends to sag, and AB forms the arc of one circle and CD the arc of another and slightly larger circle. Consequently the particles lying in the surface AB are compressed and those in CD are stretched apart. The particles in the layer just under AB are compressed but not so much as those in AB itself, and those in the layer above CD are less stretched than those in CD. Tracing the conditions in the successive layers below AB and in those above CD, we conclude that there must be near the middle of the beam a *neutral* layer, that is, one in which there is neither compression nor extension. The greater strains are to be found in the extreme top and bottom layers, and if such a beam gives way it will be due either to the bottom layer being torn apart or to the top layer buckling up under the force which presses its parts together. Provided that sufficient wood were left to maintain the upper and lower parts in their respective positions, a very large quantity of wood could be cut out from the vertical faces of the beam without seriously reducing its strength.

This leads the pupil to appreciate the form and use of an iron girder, which consists of an upper horizontal plate or " flange " which resists compression and a lower flange which resists tearing, and a vertical plate or " web " which keeps the two flanges in their proper relative position. A paper model girder can be made of three strips of drawing paper about 6 or 7 in. long and 1 in. wide. The web can be gummed to the flanges by the little flaps as shown in fig. 4. If, before joining, the three strips are laid one on top of the other across the space between two supports, it will be found that they will give way under a very small weight, but when made into a girder they will bear a much greater weight.

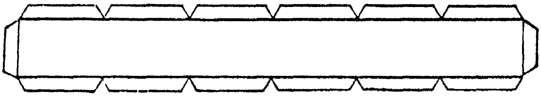


Fig. 4.—Flange of Girder

As it is the outside part of a bar that does most of the work, the pupil will see why the frame of a bicycle is made of *tubing*, which is many times as strong as a rod of the same *weight* and very much lighter than a solid bar of the same *thickness*.

The same principle is applied to the " lattice-girder bridge " in which the web is replaced by oblique bars which cross one another. A close inspection of these bars will further show that some are subject to pressure and others to tension, and that the former are of a T section while the latter are plain bars.

CHAPTER IV

The Properties of Fluids

APPARATUS

Specific gravity bottle with counterpoise.
Hydrometer.
Glass U-tube to compare densities, mounted.
Spirit level.

Force Acting on Fluids

The next point to take up is the way in which forces act on fluids. Pressure in a fluid at rest is equal in all directions—a quite different condition from what obtains in a solid. Thus in a brick wall a given course of bricks will show no tendency to move in a horizontal direction because the pressure of all the bricks is vertically downwards. The downward pressure on a layer of water similarly placed would cause the water to move outwards if it were not for the resistance of the vessel containing it.

Why some Bodies Sink and others Float.—Consider the forces acting on a cubic inch of still water in a vessel. This weighs ·576 oz. and obviously would fall towards the earth if there were nothing to support it. It is, however, maintained in its position by the pressure of the surrounding water, hence we see that the upward pressure on that cubic inch is ·576 oz., and this upward pressure must remain the same whether the cubic inch of space is filled with water or with some other substance. Suppose the cubic inch of water to be replaced by a cubic inch of lead, which weighs a little over 6½ oz. The upward pressure of ·576 will obviously be unable to support this, and the lead will sink. If the cubic inch of water were replaced by a cubic inch of ice, which only weighs ·53 oz., the upward pressure will be more than sufficient to support this and the ice will rise and float, and as it only requires the upward pressure of ·53 oz. to support it, it will only displace ·93 oz. (or about $\frac{9}{10}$ cu. in.) of water, and about one-tenth of a cubic inch of the ice will be above the surface. The laws of floating bodies can thus be stated:

1. A body floating in water displaces a volume of water whose weight is equal to its own.

2. The centre of gravity of the body is vertically below the *meta centre*, that is the point through which the upward force acts, and is obviously the centre of gravity of the displaced water.

Specific Gravity

Since a body wholly immersed in water is pressed upwards with a force equal to the weight of an equal volume of water, we can, by weighing a body first in air and then in water, compare its weight with that of an equal volume of water. Thus if a body weighs 6 oz. in the air and 4½ oz. in water, an equal volume of water will weigh 1½ oz., that is the body is 6 ÷ 1½ or 4 times as heavy as water, bulk for bulk. This quotient is called the *specific gravity* of the body, and is the same for all bodies made of the same material. Numerous experiments should be made to determine the specific gravity of different substances.

In finding the specific gravity of such a body as a cork a piece of lead heavy enough to keep both weighings under the water must first be attached. If the cork alone weighs ·25 oz., and the cork (in air) and the sinker (in water) weigh 4·25 oz. and the cork and sinker (both in water) 3·75 oz., the loss of weight is ·5 oz. and this is the weight of the water displaced by the cork. The specific gravity of cork is therefore ·25 ÷ ·5 that is ·5.

The weight of a body immersed in *any liquid* is reduced by an amount equal to the weight of that liquid displaced. By weighing a piece of lead of known weight first in water and then in alcohol, we can find the weight of a volume of each of these liquids equal to the volume of the lead, and the weight of the alcohol divided by that of the water is the specific gravity of alcohol.

The specific gravity of liquids may also be determined by means of the specific gravity bottle, which is a small bottle with a small hole drilled through the stopper. A record can be kept of the increase in weight when the bottle is filled with water, and then only one weighing is needed to find the weight of the bottleful of alcohol, petrol, or any other liquid.

The hydrometer has a scale marked on it, which shows the specific gravity of a liquid by the depth to which the instrument sinks in the liquid.

The Romans, who did not know the elementary truth that "water will always find its own level", adopted the expensive means of carrying water across a valley by an aqueduct, whereas a pipe laid in the ground would have been sufficient. This results from the fact that a fluid presses equally in all directions.

Many experiments to illustrate this can be worked with pieces of glass tubing connected with indiarubber tubing or with a long U-tube.

This property of liquids is made use of in the *spirit level*. The small bubble of air which is left in the tube rises to the middle of the tube when this is in a horizontal position. The fact that alcohol is used instead of water leads to the discovery of the fact that it flows more freely than water does, and that they differ greatly in their mobility. Compare treacle, tar, petrol, water, alcohol, &c.

With the help of the long U-tubes we can show not only that the same liquid rises to the same level in both arms of the tube even if the tubes are of different diameters, but that if the liquid in one arm is denser than that in the other, the heights of the liquids will be inversely proportional to their densities.

A saturated solution of salt can be used to fill one tube and some pure water to fill the other. To prevent the fluids from mixing and to obtain a level from which to measure the lengths of the respective columns, it is necessary to run a small quantity of mercury into the bottom of the U-tube, and to add water or brine so that the mercury stands at the same level in both arms. By weighing a pint of the salt solution, its density may be compared with that of the pure water, for a pint of water weighs 20 oz.

If the mercury stands at the same level in the two arms, the heights of the columns of liquid in the two tubes will be inversely in this ratio. As the two tubes are open at the top there is the same air pressure in each tube. If one limb were closed and filled with mercury, this long column of mercury would have to balance the short column in the other arm plus the pressure of the atmosphere. As we shall see when dealing with the barometer, the difference between the two levels is about 30 in., so that the pressure of the atmosphere is about equal to that of 30 in. of mercury.

CHAPTER V

Properties of Gases

APPARATUS

Air pump.
Model barometer.
Barometer tubing.
Model lift pump.
Model force pump.
19-in. U-tube mounted, limbs of equal diameter.
19-in U-tube mounted, limbs of unequal diameter.
Boyle's Law tube on stand.
1 lb. Mercury.
Glass funnels.
Filter stands or retort stands (iron).
Potassium bichromate.

Air and water are alike in this respect—they are able to flow, hence they are both called *fluids*, but while air can easily be compressed into a smaller volume, it is practically impossible to compress a volume of water. This constitutes the difference between gases and liquids. But a gas is like a liquid in that the pressure at any point is the same in all directions.

By means of an air pump and a suitable globe it may be shown that air has weight, and the weight of a given volume of air or other gas may be found. From this we are led to expect that the pressure of the air near the surface of the earth, having to support the weight of all the air above it, is greater than that of the air higher up; and observations on the top of a high mountain show that this is the case.

The Barometer.—The ordinary mercurial barometer consists of a tube about 31 or 32 inches long closed at the top and filled with mercury. The lower end rests in a cup of mercury. If the open end is half an inch below the surface, each particle of mercury at the mouth of the tube is subject to the pressure of the atmosphere plus that of half an inch of mercury, and in accordance with the laws of fluid pressure this must be the same in all directions. If the upward pressure were increased more mercury would be forced into the tube, and the level would rise until the pressure due to the column of mercury in the tube was sufficient to balance it. If the pressure of the air be lessened, the upward pressure at the mouth of the tube is lessened and mercury will come out of the tube until the pressure due to what is left is equal to the pressure of the atmosphere. The height of the mercury in the tube is measured from the surface of the mercury in the cup, as the pressure of the mercury between this and the mouth of the tube is the same in both directions.

The pressure of the atmosphere may be illustrated with the help of an air pump and a pair of Magdeburg hemispheres. If these are not available, a " sucker " may be made by taking a round piece of strong leather, passing a string through a hole in the middle, and, after soaking it, pressing it firmly on to a flat smooth stone, so as to drive the air out from under the sucker. It will be found that the pressure of the air keeps the sucker attached to the stone, which may generally be lifted by it, and can hardly be separated from it until air is admitted underneath it.

If two sheets of wet glass (plate glass is best) are placed together, although there is very little difficulty in *sliding* them apart, the pressure of the air makes it very difficult to pull the surfaces apart.

The pressure of the air is often used in fixing tickets to shop windows. The support is provided with a sort of cup with an indiarubber edge. When this is pressed on to the glass of the window some of the air is driven out, and that which is left inside exerts a smaller pressure than the outside air and so the ticket support remains attached to the window.

A small quantity of water may be boiled in a large tin can with a small opening which can be closed as soon as the steam has driven all the air out of the tin. If the tin be cooled, the steam then condenses and the inside pressure falls off and the outside pressure of the atmosphere crushes the tin. If the surface of the tin is about 150 sq. in. in extent, this crushing force amounts to nearly a ton.

Pumps

In the case of the common pump, the working of the handle is the indirect cause of the water rising, the direct cause is the pressure of the air on the water in the well. The up-and-down motion of the piston removes the air from the pump as the valve in the piston opens when the piston descends and closes when it rises, but the other valve closes when the piston descends and opens as it rises. The water of the pump is acted upon by two pressures, viz. the pressure of the atmosphere on the water outside tending to drive it up into the pump, and the pressure of the column of water in the pump which tends to drive it downwards. As the water rises higher and higher in the pump the latter force increases, until when the height is about 32 or 33 ft. it is equal to the pressure of the atmosphere, and no amount of work on the handle can raise water by a suction pump to a greater height than this.

If water has to be raised to a greater height than about 30 ft. a *force pump* is used. In this a force greater than, or in addition to, the pressure of the air is employed. Water does not pass through a valve, but is forced through a tube at the side of the cylinder in which the piston works. Atmospheric pressure may be used to bring the water through the valve at the bottom of the cylinder at the side.

A pump of this form would give a very jerky jet, for water would be driven out only while the piston is descending. Most force pumps are therefore provided with an air chamber into which the water is forced by the down stroke of the piston. The air in the chamber being thereby compressed drives the water out of the chamber during the upstroke of the piston, and causes a continual flow. A fire-engine is really a double pump working on this principle.

The Siphon

The pressure of the atmosphere may be used to draw water from a large jar which has no tap. All we require is a pipe or tube, one end of which can pass over the side of the jar into the water and the other hang down outside below the level of the water inside, into the vessel we wish to fill.

Spirits are often transferred from distillers' vans by means of siphons, and these have a small side tube through which the air may be sucked.

The waste preventers in our lavatories are fitted with siphons which are filled by the sudden release of a heavy plate, and the water continues to run till the cistern is empty.

In some parts of the earth there are large caverns, or masses of porous earth, which are connected with cracks or fissures in the form of siphons. When a large quantity of water has collected in the cavern, and there is sufficient to start a flow over the highest part of the crack, the water continues to run until the cavern is emptied below the outlet, and then stops until the cavern has filled again. A spring thus formed is called an *intermittent spring*.

Boyle's Law

To demonstrate this requires the aid of a U-tube with (*a*) the shorter arm closed and (*b*) the longer one open. With a little patience a small quantity of mercury may be placed in the lowest part of the tube and adjusted so that the surfaces in the two arms are level.[1] As the surface in the long arm is exposed to the pressure of the air it follows that the air in the shorter arm is exerting an equal pressure (say 30 in.).

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[1] Only a very small quantity of mercury must be poured in at first, and owing to the presence of the air in the shorter tube (*b*) the level will not at first be established. By tilting the tube over to the left, some of the air in (*b*) can escape and the mercury in (*b*) will be a little higher than in (*a*). Then by adding mercury drop by drop to (*a*), the mercury in the two arms can be brought to the same level.

Mercury is then poured into the longer arm, and after each addition two things should be noted, viz. (i) the height in inches of the surface in *a* above the surface in *b*, and (ii) the volume of the air in *b*. By adding 30 to the number obtained in (i) we find the pressure (in inches of mercury), and this pressure *will be seen to be inversely proportional to the volume* in *b*. Thus the addition of 10 in. of mercury will reduce the volume of air to $\frac{30}{30 + 10}$, that is $\frac{3}{4}$ of its original volume, and if we add 30 in. of mercury we shall double the pressure and the volume will be reduced to one-half.

In a pop-gun or a bicycle pump the volume of the air is diminished, but the pressure increases until at last in the case of the pop-gun it is sufficient to drive out the cork. With most forms of pop-gun it is easy to show that if the volume be increased the pressure is diminished.

Certain liquids and solids can be turned into gas which at the pressure of the atmosphere would occupy a very large volume, but if the change takes place in a confined space the pressure is very great. Thus a cubic inch of water would produce 1700 cu. in. of steam. The pressure which this exerts in a boiler is the force which drives our steam-engines. The high pressure of the gas produced when a small quantity of gunpowder explodes is used to drive shots forward, and the much greater pressure of the gas produced when a small quantity of dynamite explodes is used to blast rocks.

CHAPTER VI

Solution

Stir up small quantities of each of the following substances in a separate glass of water: sand, salt, sawdust, sugar, powdered copper sulphate, lime, and powdered resin. It will be seen that the salt and sugar disappear, but the others are still visible. The copper sulphate colours the water, but no solid particles are to be seen in the water, so we say that this, as well as the salt and sugar, has dissolved. The sand, resin, sawdust, and lime are visible in the water, and although the sawdust soon rises to the surface and the lime and sand sink to the bottom, we say they are *suspended.* With the help of a piece of filter paper and a funnel the sand, resin, lime, and sawdust can be separated from the water in which they are suspended, but the salt and sugar pass through the filter and by tasting the water we know that they are still there, and if the water be boiled away they will be left behind. If the water which had the suspended substances be boiled, it will be found that there is no trace of sand, resin, or sawdust, but there is a distinct trace of lime, showing that lime is somewhat soluble. Experiments may be tried with a number of substances and they will be found to vary considerably in their solubility. There is always a limit to the quantity of matter which can be dissolved in a given quantity of fluid, and when this point is reached the solution is said to be *saturated.*

An interesting experiment on saturated solutions may be performed by filling two tall glass jars with water, and in one dropping some crystals of potassium bichromate, which will sink to the bottom and begin to dissolve, forming a heavy saturated solution at the bottom of the jar, while the upper part remains clear. The crystals in the saturated solution will not dissolve, and as the heavy solution does not readily mix with the water above it, these crystals take a very long time to dissolve. Now tie a similar quantity of bichromate in a piece of muslin and suspend this by a piece of string from a rod resting across the top of the other jar. The coloured stream passing from the muslin bag to the bottom of the jar shows that solution is taking place, and fresh water passes into the bag to continue the process and the solution is completed in a comparatively short time.

Why do we stir our tea when we put sugar into it?

Most solids dissolve more readily in hot than in cold water. Make a saturated solution of sugar in hot water, pour off the clear solution from any sugar that may remain in the bottom of the vessel. On cooling the solution a large quantity of sugar will crystallize out.

Lime and calcium sulphate are more soluble in cold than in hot water. Common washing soda is most soluble at 36° C.

The mixing of liquids is closely related to solution. Alcohol and water mix freely, but if a pint of alcohol be added to a pint of water, the mixture becomes warm and measures less than two pints.

Ether and chloroform are partly soluble in water.

Gases dissolve in water to very different degrees. One volume of water will dissolve over 100 of ammonia or of hydrochloric acid. It will dissolve its own volume of carbon dioxide but only a very small quantity of oxygen, nitrogen, or hydrogen. Oxygen is more soluble than nitrogen, and so the air dissolved in pond water is richer in oxygen than the air. This is of great importance to fishes, which take in this oxygen by their gills, and if the air is getting used up, fishes rise to the surface in search of water with more oxygen in it.

The *volume* of a gas that may be dissolved in water is constant, whatever the pressure, so by multiplying the pressure we multiply the *weight* of gas that can be dissolved in a given volume of water. A soda-water siphon contains water in which carbon dioxide has been dissolved at a very high pressure. On pressing the lever the pressure of the gas drives the fluid from the siphon, and as this is caught in a glass in which the pressure is only that of the atmosphere, a large quantity of gas escapes in bubbles.

Now invert a soda-water siphon so that the end of the tube is out of the liquid. On pressing the lever the gas escapes but cannot drive out the liquid. When the pressure of the gas is reduced to that of the atmosphere it cannot drive out the soda-water, which can only be obtained by unscrewing the top, and will be found to have no longer any sparkling properties.

We found that resin is insoluble in water. Try dissolving it in alcohol. Many substances which are insoluble in water can be dissolved in other fluids, e.g. sulphur in carbon disulphide, oil in turpentine or ether. The teacher should work as many experiments in this direction as his materials will allow.

The difference between *hard* and *soft* water is best studied in connexion with solution.

Samples of distilled or rain water should be compared with samples, say, of Thames water. Very little soap is required to wash the hands in rain water, and there is a different feeling after the hands are rinsed. Again, if a quantity of distilled water be boiled quite away in an evaporating dish, the dish is left quite clean and bright, but Thames water so treated leaves a perceptible deposit on the dish. On examining a kettle that has been in use for some time we shall find a thick coat of " fur ". This material was at one time part of the chalk hills in the Thames basin and entered the kettle in a state of solution. But how could it have been left there, as the kettle was not boiled dry, like the exaporating dish, each time it was used? A simple experiment answers this question. Take some lime-water in a beaker and breathe into it through a glass tube; it soon becomes milky because the carbon dioxide in the breath unites with the lime to form chalk, which is seen in suspension. On continuing to breathe into the beaker, the chalk dissolves and the fluid becomes clear again. If this is boiled, bubbles of carbon dioxide are seen to escape and the chalk is deposited. Similar changes have taken place in the water supplied to our houses. As the rain passed through the air it took up some carbon dioxide, which enabled it to dissolve some of the limestone from the hills through which it soaked. When finally it was put in the kettle and heated, bubbles of the gas were driven off as the kettle began to " sing ", and the limestone was deposited on the inside of the kettle. Water that has been boiled will prove to be soft. This is one way of softening water, but it would be a very expensive way of softening a large quantity of water.

Take a beaker full of *hard* water. The class will remember that the chalk in this is dissolved because the water also contains carbon dioxide. Add a few drops of lime-water and a cloudy mass of chalk at once appears. This is really a double quantity of chalk, one part formed by the union of the lime with the CO_2, which cannot now help the water to dissolve the original chalk, which consequently is precipitated with the new chalk, and when it has all settled the water will be clear and *soft*.

CHAPTER VII

Light

APPARATUS

Wire pyramid to illustrate law of inverse squares.
Refraction trough.
Concave mirror on stand.
Convex mirror on stand
Apparatus for showing formation of image by lens.

The pupils no doubt understand what is meant by *opaque* and *transparent* substances, and the difference between a *luminous* body and a *non-luminous* one and can draw up lists of them. Note that transparency admits of degrees.

One fundamental fact in connexion with light is that in the same medium, e.g. air, it travels in straight lines. We are able to see an object by means of the rays which pass from that object and enter our eyes. An opaque body placed in the *straight line* between the eye and the object will prevent the light from reaching the eye.

Shadows.—If an opaque object is placed between a light and a screen it shuts off part of the light which would fall on the screen and a shadow is produced, and we can learn many things from the study of shadows.

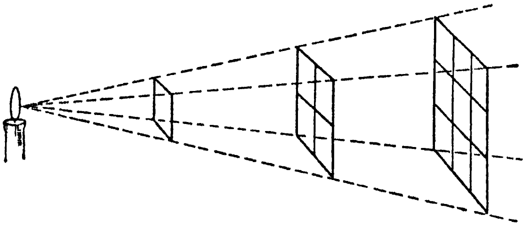

Fig. 5 —Intensity of Light

If the source of light is brilliant and very small the shadow is sharply defined, but if the light comes from a large surface, then each point casts its own shadow, and the shadows due to some points fall on parts of the screen which are lit up by the light from the other points, and the result is a dark part in the middle where all shadows coincide surrounded by a fainter shadow. This may be illustrated by holding a small stick like a lead pencil near a wall or screen lit up by the sun, and gradually moving it away. The deep part of the shadow grows smaller and the faint part extends, until at last there is no deep part and finally the shadow cast by any one point on the sun's surface is so overpowered by the light from the other parts that it is no longer visible. The shadow of the earth on the moon when there is an eclipse of the moon presents the same characters. The deep part of the shadow is called the *umbra* and the outer pale part the *penumbra*.

Intensity.—With the help of a square card and a movable screen we can illustrate an important rule regarding the intensity of light coming from a point and falling on a screen. Fig. 5 shows that the light from the candle which falls on one square foot of a screen one yard away would be spread over *four* square feet on a screen two yards away, or on *nine* square feet at three yards' distance, and as that quantity of light is distributed over four or nine times as much surface it can only be a *quarter* or a *ninth* as intense. In general terms the intensity of the light varies inversely as the square of the distance.

Reflexion.—To demonstrate the laws of reflexion properly, a darkened room is required, then with the help of a plane mirror and a semicircular protractor fixed perpendicularly to it, it should be possible to arrange a beam of light so that it strikes the mirror at the point immediately in front of the centre of the semicircle, i.e. at the foot of the perpendicular mark on the scale.

The ray of light falling on the reflecting surface is called the *incident ray*, and the perpendicular line at the point at which it strikes is called the *normal*. The angle between the incident ray and the normal is called the *angle of incidence* and that between the normal and the reflected ray is the *angle of reflexion*.

A knowledge of this law may help us to find, for instance, a bright coin that has been dropped on the ground.

It should be noted that if the mirror be slightly rotated, the reflected ray turns through an angle twice as great as that through which the mirror turns, because the normal being always at right angles to the mirror, the angle of incidence and the angle of reflexion are *both* increased by the number of degrees through which it (and the mirror) moves, and consequently the angle between the incident ray and the reflected ray is increased by *twice* that amount.

By allowing the light from a candle or other object to fall on a mirror (or bowl of water) at different angles it will be found that the brightness of the image (which of course depends on the amount of light reflected) increases as we increase the angle of reflexion.

The amount of light reflected also depends on the smoothness or polish of the surface; the more highly it is polished the greater will be the amount of light reflected, and the sharper or more clearly defined will be the image. The class should notice that in the case of an image in a mirror the image of each part is opposite the part of which it is the image, and so the image is *laterally reversed*. This fact is very noticeable when looking at the image of a printed paper. The marks made on a sheet of blotting paper by writing in which the ink has been liberally used form a laterally reversed copy of the writing and are not easy to read. If this blotting paper is held up in front of a mirror the writing is again reversed and can be easily read. Other interesting facts can easily be shown by experiment and observation, and worked out by the pupils with diagrams on paper.

(*a*) An observer can see the whole of himself reflected in a mirror the length of which is half of his own height (fig. 6).

(*b*) The portion of the plane which is parallel to the mirror and in which the observer's eye is situated is twice as long and twice as broad as the part of the mirror in which he is reflected.

(*c*) If a mirror is placed so as to show the image of another mirror it not only reflects the mirror itself but also the images that are formed by that mirror.

(*d*) An object placed between two parallel mirrors not only causes an image in each, but the image in one is reflected in the other and these seem to be repeated indefinitely, but practically only until they become too feeble for the eye to perceive them. The pupils will be familiar with shops in which the opposite walls are covered with looking-glass, with the result that the interior of the shop or department seems to be repeated a great number of times.

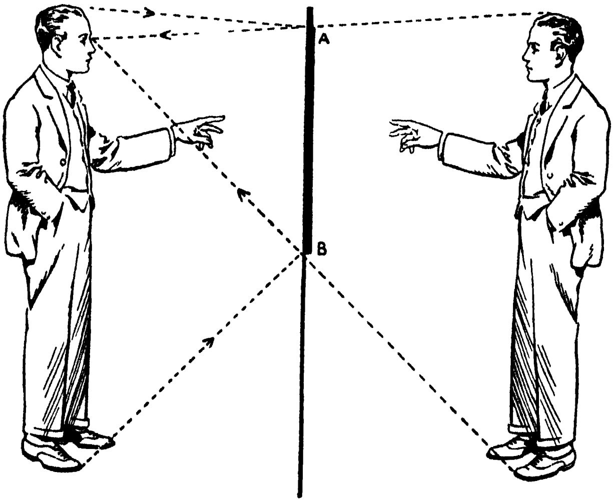

Fig. 6.—Reflexion

(*e*) If two plane mirrors are fixed at an angle the image is repeated several times in a circle the centre of which is the meeting-place of the planes.

(*f*) The kaleidoscope is a simple and interesting application of the preceding and can easily be constructed by the pupils, provided a number of circles of glass about two inches in diameter and some strips about 6 in. long and nearly 2 in. wide can be obtained.

Three strips of glass should be placed edge to edge so as to form an equilateral triangular prism, and enclosed in a roll of dark paper which will keep them in place and project for a short distance beyond them at each end. At one end a glass disc should be fixed, touching the ends of the glass strips; on this are placed small scraps of coloured glass, and the second disc is then fixed parallel to the first, but at a sufficient distance to allow the scraps of coloured glass to fall freely when the kaleidoscope is rotated. It is preferable to have the outer disc of ground glass, as this shuts out the appearance of all objects except the coloured fragments. An advantage is gained if the outer surface of the glass strips is coated with a black pigment. If obtainable, silvered strips of glass are best. A number of symmetrical patterns will be seen on looking through the tube, and these will be varied to an infinite extent as the kaleidoscope is rotated.

It is possible to make a good kaleidoscope with *two* glass strips, but *three* give much better results. Many of the patterns seen in the kaleidoscope will furnish suggestions for designs for carpets, &c.

Real and Virtual Images.—In a plane mirror the image of an object appears as far behind the surface as the object is in front, but in the case of a convex mirror the image appears to be much nearer the surface of the mirror. In both cases the image is behind the mirror, but the rays of light do not, of course, actually come through the mirror. Now look at the reflexion of a candle flame in a concave mirror. At first sight it seems as though that also is behind the mirror, but by making a spot on the mirror and looking at it from different positions it will be seen first on one side and then on the other in a way that is only possible if the image is in front of the mirror, and a thin stick may be set up to mark the position of the image and the observations repeated. If a sheet of tissue paper be placed in this position a real but inverted picture of the candle will be formed on it. These observations prove that the rays of light which enter the eye proceed from this point in front of the mirror, and that an image is really formed there. This is called a *real image*, while an image behind the mirror from which the rays of light only *seem* to come is called a *virtual image*.

Refraction.—We have shown that rays of light, *if they are passing through the same medium*, always travel in straight lines. A simple experiment is sufficient to show the necessity for inserting the conditional clause in the statement. Place a coin in the bottom of an empty opaque bowl or basin, and stand at such a distance from it that the edge of the basin is below the straight line between the coin and the eye. The coin is visible. Now move just so far away that the coin disappears, because the side of the basin comes in the straight line between the coin and the eye. If water is poured into the basin, the coin and eye remaining in position, the coin will reappear, which suggests that rays of light from the coin when passing from water into air are bent.

A ray of light coming through a small hole in a blind or screen is allowed to fall on the bottom of an empty basin and the position of the spot of light is noted. On pouring water into the basin this spot changes its position, showing that the ray of light is bent on passing from air into water. The bending of rays of light when passing from one medium to another is called *refraction*. The chief laws of refraction are easily explained with the help of a simple diagram. They are very similar to the laws of reflexion; in fact when a ray of light falls on such a substance as glass or water, part of it is reflected and only a part enters the water and is refracted, but the incident ray, the reflected ray, the normal and refracted ray are all in the same plane.

When a ray passes from a dense to a rare medium it is bent *from* the normal, and in the case of a ray passing from water into air, as the angle of incidence increases, the amount of light reflected increases and the amount refracted diminishes until when the angle of incidence reaches 49 degrees the whole of the light is reflected.

If a glass of water is held so that the surface of the water is only a little above the level of the eye the whole surface of the water appears like a mirror, and if the eye is just a little below the level of the water in an aquarium a fish swimming near the surface is seen reflected in the clearest possible manner.

Specimens of different kinds of lenses should be shown, and with the aid of calipers (or even the fingers) they can be arranged in two classes, (*a*) those that are thickest in the middle and (*b*) those that are thinnest in the middle. The former we call *convex* lenses, the latter *concave*. With a convex lens the sun's rays can be brought to a focus and the heat rays may be so intense as to burn a piece of paper. The distance of this focus from the lens should be noted, and this is known as the focal length. Now if the lens be fixed with a piece of paper placed at the focus, care being taken not to turn it towards the sun and to screen as much light as possible from the paper, except what passes through the lens, a picture of the objects in front of the lens will be seen on the paper. This is a *real image*. No real image can be formed with a concave lens, and by applying the laws of refraction to a sectional diagram it is evident that a concave lens causes the rays that pass through it to *diverge*. If a slightly concave lens is placed between the lens and paper in the previous experiment the image will become indistinct, but if the paper be moved farther back, the image will become sharp and clearly defined again.

Experiments with a convex lens will show that the distance from the lens at which the sun's rays cause burning is the distance at which images of remote objects are formed. This distance does not change much until the object comes within a few feet of the lens, but as the object approaches the lens the paper has to be moved farther back. If the paper is too far back at first to receive the image of an object, the image can be made to fall on the screen, either by bringing the object closer to the lens, or by placing a concave lens either in front of or behind the convex one.

Some people have the lenses of their eyes so strong that the image falls in front of the network of nerves or retina at the back of the eye, and in order to make it fall there they have to hold the object close to the eyes. These people are said to have *short* or *near* sight. To remedy this they need *concave* spectacles. In other people the distance between the lens and the retina is too great, and they can best see things at a distance. They require *convex* spectacles.

On comparing different convex spectacles it will be found that the more convex the lens the shorter the focal length. As our eyes have to be used for both near and distant objects they are provided with some delicate little muscles which can flatten out the lens by pulling at the edge, and the image, which would have been formed in front of the retina, falls on the retina itself. When these muscles stop acting the lens thickens up again of its own elasticity and causes the image of distant objects to form on the retina. The power of altering the convexity of the lens generally decreases with age.

The Spectrum

When a beam of sunlight passes through a glass prism, it is not only refracted, or bent out of its course, but it is spread out into a band of different colours; these are most distinct if the light passes first through a narrow slit. This shows that sunlight is a mixture of rays of light having different wave-lengths; the rays with the shortest wave-lengths are refracted most. If instead of sunlight we use the light from a Bunsen burner in which we place a wire previously dipped in common salt or soda, the spectrum shows two bright yellow bands which practically obscure the rest. The effect of such compounds as calcium chloride or potassium nitrate can easily be shown to the class, and used to explain that the spectrum of each element is characteristic of that element, and that when light is examined by a special apparatus—the spectroscope—it is possible to determine from what bodies the light is produced.

Colour.—To obtain the full spectrum it must be formed on a *white* sheet of paper or cloth. If it falls on a blue cloth the blue band of light will appear somewhat intensified, while the other colours disappear. If it falls on a screen of any other colour, that colour alone is visible, the others disappear. These experiments explain the cause of colour, viz. that different bodies have the power to reflect rays of certain colours and to absorb or destroy the other rays. Thus the green leaves of plants reflect the green rays, which then enter our eyes, while the flowers of the buttercup reflect the yellow rays. A white object reflects practically all the rays equally and a black one absorbs almost all.

Certain substances, as coloured glass, will transmit certain colours and stop rays of other colours. Thus if we look at a red tulip through red glass the flower is seen distinctly enough, but the green light reflected by the leaves is cut off and they appear almost black. A number of very interesting observations can be made by the class with the help of a few squares of different coloured glass. Many substances are of one colour when seen by reflected light and another when seen by transmitted light. Gold has a characteristic colour when the light reflected from a gold surface reaches the eye, but the light which comes through a sheet of gold leaf placed on a window-pane is a beautiful blue. If a few drops of red ink are mixed with a glass of water the solution is green by transmitted light.

It should be impressed upon the class that few objects in nature reflect only one set of coloured rays; a red flower generally reflects a few yellow or orange rays along with its mass of red ones, and by adding a yellow pigment to a blue one we generally obtain a green. A useful exercise can be worked out in the art room by mixing paints, but it must be remembered that paints are chemical substances, and when put together they may produce a compound which does not reflect light which is a mixture of that reflected by its constituents.

CHAPTER VIII

Heat

APPARATUS

Thermometers.
1 Six's maximum and minimum thermometer.
Copper calorimeters 4 in. high, 2 in. diameter.
Set of 5 balls of equal mass (specific heat).
Apparatus for breaking iron bar by contraction.

Numerous experiments are necessary to impress on pupils the difference between *temperature* and *quantity of heat*. Certain things must be taken for granted and regarded as axioms, e.g. that the heat given out by the steady flame of a Bunsen burner is proportional to the time, and that the thermometer registers *temperature* and not quantity of heat (at least not directly).

1. Note how long it takes to raise the temperature of one pint of water from say 60° to 160° F., and compare this with the time needed to raise 2, 3, or 4 pints through the same number of degrees. The class concludes that the larger quantities of water have had more heat put into them to bring them to the same temperature.

2. Pour some hot water into some cold water. The heat of the former is in the mixture, but the mixture is at a lower temperature as shown by the thermometer.

3. A test tube full of water at 100° F. plunged into a vessel of water at 200° is warmed, i.e. it receives heat, but if plunged into a vessel of water at 40° F. it is cooled, i.e. it parts with its heat.

This will make clear what is meant by the *temperature* of a body, viz.: The temperature of a body is that property in virtue of which it will communicate heat to or receive heat from other bodies.

If a body x imparts heat to a body y, we say that the temperature of x is higher than that of y. Temperatures then can be arranged in order and numbered like the houses in a street, and just as the number of a house simply indicates its position with regard to houses with different numbers, so the number of degrees which expresses the temperature of a body simply shows that it can receive heat from bodies at a higher temperature or give heat to bodies at a lower one.

Heat consists of a motion of the particles of a body, and is best studied by considering its effects, which are as follows:

1. Heat causes a rise in temperature; the more heat put into a body, the more readily as a rule will it part with it.
2. Heat causes bodies to expand.
3. Heat causes bodies to change their state. A solid may be turned to a liquid—fusion; a liquid turned to a gas or vapour—evaporation.

Each pupil can demonstrate for himself the expansion of solids, by cutting a piece from the side of a block of wood and sticking two upright needles *a* and *b* in one end, letting the end of a horizontal needle *c* rest against *a* (fig. 7). The experiment works better if the top part of the eye of the horizontal needle has been broken off. On heating this needle in a candle flame or bunsen flame, it expands and pushes the upright needle *a* away from *b*, which serves to show how much it has moved.

An almost endless variety of illustrations of expansions of solids by heat will occur to the teacher: the heating of an iron tire before placing it on a wheel; the necessity for leaving a small space between railway lines; the special joint in the middle of a long rod for working railway points and signals; the use of hot rivets (not simply because they are more easily burred); the greater liability of *thick* glass to break when suddenly heated; removal of a fixed stopper by *carefully* warning the neck of the bottle.

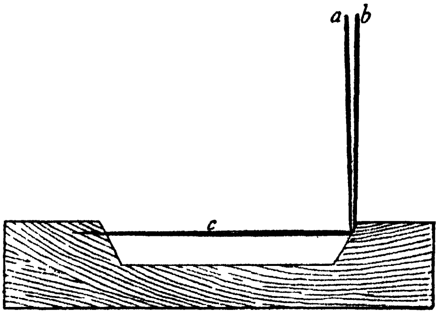

Fig 7 —Expansion of Solids

The expansion of liquids by heat may be shown by fitting a flask with a cork through which passes a narrow glass tube. This can be filled with water reaching to about the middle of the tube. The narrower the tube the greater will be the rise. In working this the water sinks before it begins to rise, owing to the fact that the bottle is heated and becomes larger before the heat affects the water.

By carefully working a drop of coloured water into the middle of the empty tube, the same flask may be used to demonstrate the expansion of air, or the flask may be inverted and the end of the tube placed under water, when the expansion of the air will be shown by the bubbles coming out of the tube.

Winds are caused chiefly by the expansion of the air by heat from the sun.

There are three ways in which heat may be transferred from one body to another: 1, conduction; 2, convection; 3, radiation.

Conduction

In this case heat passes directly from one part to another of the same body, or from one body to another which is in contact with it. If a silver spoon be placed in a cup of hot tea the bowl receives heat from the tea, and heat is transferred up the stem to the handle; both are cases of conduction. A long list of instances of conduction can be elicited from the class.

Some substances conduct heat much better than others. Generally speaking the metals are much better conductors than the non-metals, but these differ widely among themselves. Some of the better known metals arranged in order of conductivity are: silver, copper, iron, zinc, tin, lead.

Silver is a better conductor than nickel. Place a silver spoon and a plated one in the same cup of hot water; the warmth of the handle soon shows which is the silver spoon.

Carbon is a poor conductor, and a very impressive class experiment is to take a kettle well coated with soot, fill it with boiling water and rest it on the bare open hand; it will scarcely feel warm. If the kettle is taken directly from the fire, see that no hot coals are clinging to the bottom, and do not repeat the experiment with a new or clean kettle.

Why does a copper kettle boil more quickly than an iron one?

Saucepans and laundry "coppers" are now generally made of iron, because iron is much cheaper than copper. Aluminium is a good conductor.

Bodies which have been standing in the room a sufficiently long time all acquire the temperature of the room, but if the warm hand be placed on a metal object, that object seems colder than the wooden table. This is because the metal object, being a better conductor than wood, draws heat more readily from the hand. But if both objects are at a higher temperature than the hand, the iron will feel hotter than the wood, for although they are both at the same temperature, the iron *conducts* heat *into* the hand more readily than the wood.

It is fortunate that all things are not good conductors, and many things owe their usefulness to the fact that they are bad conductors. A hot saucepan may be stood on an asbestos mat without risk of burning the table underneath, and asbestos is used for packing steam-pipes and the sides of gas cookers in order to prevent the escape of heat.

Air is a bad conductor of heat, and the fur of animals and our own clothes owe their usefulness mainly to the air which is imprisoned in them. In part they owe it to the materials themselves, and so woollen clothes are warmer than cotton ones, flannel is warmer than flannelette, real silk than artificial silk. The handles of teapots, soldering irons, and other things which have to be handled while hot are made of non-conducting materials.

Note the different results obtained by heating a long test-tube full of water (*a*) at the bottom, (*b*) near the top. In the first case convection currents are set up and the whole of the water becomes hot. In the second case the water at the top may be brought up to boiling-point while that at the bottom may remain so cold that the test-tube can be held in the hand without any inconvenience, showing that water is a bad conductor of heat.

Convection

Here heat is *conveyed* from one body to another or to another part of the same body by matter which is itself heated. The absorption and emission of heat in this case is generally due to conduction. Thus by conduction the air over a hot part of the earth's surface is heated, the air moves, as a wind, to a cooler part of the earth *conveying* heat with it, which it then gives up. If a glass vessel full of water be heated below by a Bunsen burner, the warm water from the bottom will rise to the top, carrying heat with it; such a current is called a *convection current*. The presence of small particles suspended in the water will make the current more evident. If two flasks are fitted as in fig. 8, and the lower one filled with water slightly coloured and the other with clean water, on heating the lower flask its warm contents will rise and change places with the cold water in the upper, *conveying* heat with it. This explains the principle on which schools and other buildings are heated by the circulation of hot water through pipes and radiators, and hot water passes from the boiler in the kitchen to the hot-water cistern in the bath-room. Of course, it is really a case of convection when heat is *conveyed* to the bedroom in a hot-water bottle from the kettle in the kitchen, but when the bottle has been placed in the bed, the sheets are warmed by conduction.

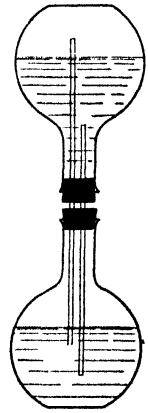

Fig. 8.—Convection Current

Radiation

It is not by either of these processes that heat passes from the sun to the earth. The air and whatever other matter there may be between the earth and the sun is not appreciably heated by the passage of heat through it, and as the heat passes outwards in straight lines from its source, this method of transfer is called *radiation*. Instances of radiation are numerous and will readily be supplied by the class. The hot-water radiator in the classroom supplies a combination of all three methods of transfer: heat passes into the water from the boiler by *conduction*, it passes with the water into the radiator by *convection*, it passes into the metal of the radiator by *conduction*, and then by *radiation* to the people and objects in the room.

The winds and ocean currents supply examples of convection. The actual currents are due to the expansion of air and water by heat. A mine can be ventilated by having a shaft at each end, and heating the air in one shaft. The hot air will rise through this shaft and cold air will pass into the mine down the other shaft.

The fire in a room heats the air and causes it to pass up the chimney, when cold air to continue the current enters the room through the window or door. Sometimes this causes a down draught in the chimney of another room, and a difficulty is felt in lighting the fire in that room. This can be got over by burning some paper at the bottom and warming the air in this second chimney.

It can be easily shown that an object standing in front of the fire becomes hotter than the air between it and the fire. If the front of a thermometer is turned towards the fire it soon becomes hot and the mercury rises much higher than it would if the back were towards the fire, although it would then register the temperature of the surrounding air.

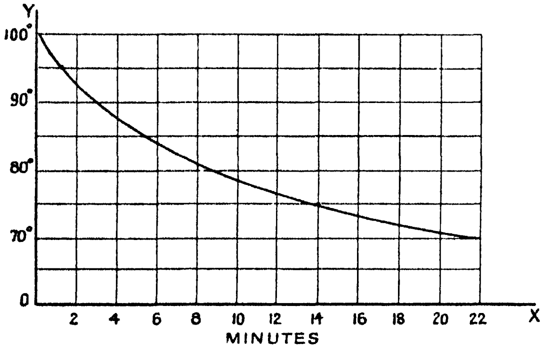

Fig. 9.—Cooling Curve

The use of screens as a protection from heat shows that heat is radiated in straight lines, and the screen throws a sort of heat shadow.

Any hot body will part with heat by radiation, and it is a very useful exercise for the class to plot a *cooling curve*. Place a thermometer in a vessel of hot water, and on the squared paper let horizontal distances from O towards X denote time, and vertical distances from O towards Y record the temperatures (fig. 9). A dot is marked on the paper at the end of each minute, and at the end of the time a curve is drawn passing through these points. This curve represents the rate at which the water is cooling. Such curves are very useful in correcting observations on the heating and cooling effects of electric currents, &c., but in the elementary course their use lies in the way they record the radiation of heat from different surfaces. If a bright tin can be used in this experiment and a cooling curve taken, and if the surface of the can be coated with lamp black or soot by holding it in a smoky flame, and the experiment repeated, the curve will show that cooling goes on more rapidly than before.

It is easy to reverse this experiment by making two sets of observations with the tin placed at the same distance in each case from a fire, or other source of constant radiant heat, the tin being filled with *cold* water. It will be shown by the curve that more heat is *absorbed* when the surface is black than when it is bright. Numerous other observations show that the bodies that radiate most freely also absorb most freely.

Bright steel fire-irons absorb very little heat from the fire (they reflect it) and feel cool when handled, but a black or rusty iron poker lying in the same position before the fire soon becomes too hot to use.

A dark china teapot radiates heat freely if left on the table, but if stood in front of the fire it absorbs some of the heat radiated from the fire. A bright metal teapot does not absorb much heat if placed in front of the fire, but radiates very little if left on the table. The air in contact with it will take some of its heat by conduction, and to prevent this from being *conveyed* away it is often covered with a teacosy. A covering which fits *tightly* over a metal teapot does not keep the heat in, but causes loss of heat by increased radiation.

Specific Heat

If hot water is poured into a cold vessel some of the heat of the water is used to warm the vessel and the temperature of the water falls. Different vessels will take up different quantities of heat. Experiments can easily be worked to show this if a good number of vessels are available. The quantity of heat required to raise the temperature of the vessel is called its *thermal capacity.* This will depend upon two things: (i) the mass of material of which the vessel is formed, e.g. a thick metal pot has a greater capacity for heat than a thin one; and (ii) the substance of which the vessel is made. If we had three vessels of the same weight made respectively of aluminium, iron, and silver, the aluminium vessel would take up nearly twice as much heat as the iron, and nearly four times as much heat as the silver vessel to produce the same rise in temperature. The quantity of heat that any substance takes to raise its temperature one degree, compared with that required by the same weight of water, is called its *specific heat.* A set of small balls of different metals, but of the same weight and heated to the same temperature, when placed on a thin sheet of wax will sink into it or melt a hole right through it at different rates, showing that while their temperatures fall through the same number of degrees they give out different quantities of heat.

We might warm our beds in winter by using a hot-water bottle or a flat-iron, but half a gallon of water, which weighs 5 lb., would give out nine times as much heat as a 5-lb. flat-iron in cooling through the same number of degrees.

The important consequences of the high specific heat of water should be pointed out, especially its effect on climate. A hot wind passing over the sea is cooled, as the sea can receive a large quantity of heat while its temperature rises a very few degrees, and when a cold wind passes over the sea this heat is available to raise its temperature. " A cubic foot of water in losing one degree of temperature would raise 3234 cu. ft. of air one degree."

The materials of which dry land is composed have a very much lower specific heat, and consequently the power to equalize the temperature of the wind is very much less, which accounts for the fact that the climate of an island is less subject to extremes than that of a place surrounded by great stretches of land. The winter in Iceland is generally warmer than it is in the north of Italy, although it is much farther north.

Latent Heat

One of the effects of heat is to cause a change of state, e.g. from the solid to the liquid or from the liquid to the gaseous. We assumed that the quantity of heat given out by a constant source of heat was proportional to the time, but although this may be shown by heating water over a Bunsen burner, no rise in temperature is shown while ice is turning into water if the ice and water are intimately mixed. Careful measurements show that the heat that would raise 79·4 lb. of water through one degree would just convert one pound of ice at 0° C. into a pound of water at 0° C. Before the real nature of heat was understood this heat was thought in some mysterious way to be *hidden* in the water, and hence it was called *latent heat.* Although we still use the name, we know that heat is a kind of motion, and that in converting ice into water we increase the small amount of movement that the molecules of ice are exercising into the much freer movement of the molecules of water. When water turns into ice the reverse process takes place. If it were not so, directly the temperature fell to freezing-point the whole mass of water in our cisterns, ponds, lakes, and the ocean itself would become solid ice. But as soon as a small quantity of water at the surface turns to ice it gives out heat which prevents this sudden change in the rest of the water.

The internal motion of the molecules of water is greater than that of the atoms of ice, but that of the molecules of steam is very much greater still. To increase the motion to this extent, it requires the same amount of heat to convert a pound of water at 100° C. into steam at the same temperature as it would to raise the temperature of 537 lb. of water 1° C. Here again the steam on condensing to water would give out the whole of this heat.

Give instances of heating by steam, e.g. railway carriages by spare steam from the engines.

Many instances of cooling by promoting evaporation can be cited: covering the milk bottle or the butter dish with a cloth that dips into water to keep it wet; the use of wet unglazed earthen pot. Wetting the hands or face has a cooling effect. Although alcohol has a lower specific heat than water it has a greater cooling effect because it evaporates more rapidly. Ether evaporates more quickly still as it boils at 35° C., and so produces a greater cooling effect than alcohol. A small quantity of water in a watch glass may be frozen by directing a spray of ether on to the bottom of the glass.

CHAPTER IX

Magnetism and Electricity

APPARATUS

Pair of magnets, 6 in.
Magnetic needle, 3 in., and support.

Magnetism

Magnetism is generally defined as the power that certain bodies possess of attracting small pieces of iron and certain other substances. In certain cases, as in a steel bar, this property is fixed; in others, as when it is caused by an electric current, it is only temporary.

One of the first experiments to show with a bar magnet illustrates its power to *induce* magnetism in other bodies. If a piece of iron, previously shown to be non-magnetic, is placed at the end of a bar magnet, it acquires magnetic properties even when it is separated from the bar magnet by a short interval.

If a sheet of paper be laid over a bar magnet and sprinkled with iron filings, the filings will arrange themselves in curved lines; as those nearest the bar are induced to become magnets, these attract other particles and the process is continued until the lines are formed.

If two magnets are used the forces exerted by their ends are found to be different. The end of one magnet will attract one end of the other bar but will repel the other end. If the bar be placed on a block of cork floating on a bowl of water it will turn round and finally take up a position pointing north and south, and if this is repeated the same end will always point to the north. It can then be shown that the north-seeking end of one magnet repels the north-seeking end of the other, but attracts the south-seeking end.

By lifting pieces of iron of different sizes, the magnetic forces can be shown to be most powerful near the ends of the magnet and to fall off rapidly towards the middle, where they are neutral.

Rods and bars of steel and iron can be magnetized by stroking them a few times in one direction from end to end. If a magnetized knitting needle be broken in two, each half is found to be a complete magnet, of which the two ends are different poles. If a piece of steel is left in a magnetic field for some time it will become magnetic, and the steel works of a watch are sometimes spoilt in this way.

If a magnetic bar or needle is hung up by a thread the " twist " of the thread is generally sufficient to prevent the needle from setting itself in a north and south direction, but a needle supported on a point or hanging by a single silk fibre so that it is free to turn will readily set itself. The line in which the needle sets itself is not exactly north and south, and so is not quite the same as the true meridian through the same point.

The angle between the two is called the magnetic declination of the place. It differs considerably from place to place, but when it is known the magnetic needle enables us to tell the true north. Reference should here be made to a ship's compass and its workings.

The most common form for a magnet is the " horse shoe ", in which the two ends of the bar are bent round so as to be near one another. This is a great advantage, as both ends can be used to attract one piece of iron. The strength of such a magnet will fall off if left to itself, but if a short bar of iron is left attracted to the magnet its strength is preserved. Such a piece is called an *armature.*

Electricity

Electromagnet, 6 in., with armature.
Electric bell.
Battery for " torch ".
Platinum and silver chain.

Specimen cells.
  Daniell—pint.
  Bunsen—pint.
  Bichromate—pint.
  Leclanché—pint.

As in the case of heat, so in the study of electricity it is best to consider what it *does* before investigating what it actually *is*, and considering the time at our disposal and the vastly greater importance of current electricity, it is best to touch very casually on frictional or statical electricity, in spite of its historic interest. It was known in 600 B.C. that when amber was rubbed it would attract light bodies, and at the end of the sixteenth century Gilbert found that many other bodies possessed the same property. This property should be shown in class. In 1727 Gray showed that electricity could be conducted along some bodies but not along others. This electrical conductivity varies greatly like that for heat. Soon after this the existence of two kinds of electricity—positive and negative—was discovered.

About 1780 two Italians, Galvani of Bologna and Volta of Pavia, discovered that a current of electricity might be produced by the contact of two different metals. The effect of this current was first noticed when it passed through a dead frog, and the effect of a mild current on the nerves can easily be shown to the class by giving them a mild shock.

The second effect to be shown may well be that of chemical decomposition. Water can be decomposed by an electric current, and if more than one apparatus can be arranged in one circuit it may be shown that the current is of a uniform strength throughout the circuit, as the same amounts of gas are liberated at each point. An exact determination of the amount of electricity that passes through a circuit in a given time can be made by weighing the amount of silver deposited in a platinum bowl.

The third and perhaps the best known result of the passage of electricity is the production of *light* when passing through the filament of a lamp, and of heat when passing through the resistance coils of an electric radiator.

The magnetic properties acquired by a coil of wire when a current passes through it can be shown, and the great magnetic force acquired by a bar of iron when a current passes through a coil of wire which is wound round it.

Given a supply of wire and short lengths of iron rod, the pupils can easily wind electromagnets, and are always greatly impressed by their lifting power. A horse-shoe magnet will lift a knife or other object weighing a few ounces, but an electromagnet will lift the fireguard or other object weighing pounds. This power falls off directly the current is broken and a small steel spring is sufficient to pull the armature away from the magnet. Knowing this the pupils will be able to form an " automatic make and break ", which is the essential feature of a vast number of electrical appliances. The construction is easily understood by reference to the path of the current. One more step brings us to the electric bell, which is simply an automatic make and break with a hammer fixed to the armature, and with a bell placed in a suitable position for receiving the blows of the hammer.

The essential part of the telephone transmitter consists of a thin plate which takes up the sound vibrations from the air and so very rapidly makes and breaks the electric current in the wire behind it. This intermittent current flows through the telephone wire to the receiver at the other end, where is passes round an electromagnet. Each time the current passes the magnet attracts a like disc, which springs forward again when the current breaks. These changes occur with extreme rapidity, and the vibrating disc propagates sound waves in the air which are an exact reproduction of the sound waves which caused the disc in the transmitter originally.

The head-phones and loud-speakers of our wireless sets are constructed on the same principles.

There are many other applications of electromagnetism; one very interesting one might be mentioned to the class. It sometimes happens that a workman turning or cutting iron may have the misfortune to run a small piece into his eye. It would be very difficult and very painful to extract it by an operation such as would be performed in extracting a similar piece from his hand, but by holding an electromagnet near his eye and switching on the current the piece of iron can be drawn out at once.

In dealing with electric circuits in the classroom the pupil will have come to the conclusion that no current will flow unless the circuit is *closed*. He will then be surprised when he learns that only a single wire is used to convey the current for telephones and telegraphs. This may be explained by regarding the earth as a return wire, or as a vast reservoir, which can either give up or receive considerable quantities of electricity without having its electrical condition much altered.

This leads to the study of *potential* or *electromotive force*, which is best understood by a comparison with pressure in the case of water. The flow of water from a tap or other outlet depends not simply on the quantity of water in the cistern, but on the " head " or height of the surface of the water above the outlet. This is a measure of the pressure which drives the water out. The difference between temperature and quantity of heat was emphasized in previous lessons, so the pupils should have no difficulty in appreciating the difference between potential and quantity of electricity. Then just as water will flow from a high level to a low one, and heat from a body at a high temperature to one at a low temperature, so electricity will pass from a place where the potential is high to one where it is low, and to set up an electric current we must find a means of raising potential. This may be done in a variety of ways: (1) by friction; (2) by chemical action; (3) by moving a coil in a magnetic field; (4) by evaporation; (5) by cleavage; (6) by pressure. The last two are of only theoretical interest, and (4) may just be referred to in passing as the cause of thunder and lightning, when the electricity is discharged from the clouds by a violent " spark ".

1. If a glass rod be rubbed with a woollen cloth its potential is raised and that of the cloth is lowered. The quantity of electricity generated is small, but the potential is so high that the electricity will pass through the air in the form of a spark. A similar result is obtained by rubbing a stick of sealing-wax, but the potential of the wax is lowered. Many other substances, e.g. sulphur, cat's fur, and shellac, will produce electricity when rubbed.

2. If two dissimilar pieces of metal touch one another the potential of one is raised, that of the other is lowered, and a current will pass through a wire, or other conductor, which joins their other extremities. If a half-crown or a disc of zinc be placed under the tongue and a penny on the top of the tongue, a current will be felt passing through the tongue when the two discs are allowed to touch in front of the tongue.

Any available forms of cell—Grove, Bunsen, Leclanché, &c.—should be shown and explained. The advantage of the Leclanché cell is that it depolarizes itself if left unused for a short time. Dry cells, including the small " batteries " used in flash lamps, do the same.

An " accumulator " as used with a wireless set should be shown. Here the potential is set up by immersing lead plates coated with lead oxide in dilute sulphuric acid. The current is maintained by the chemical action which converts the per-oxide into mon-oxide. This can be re-converted by passing an electric current into the cell for some hours. The name " accumulator " is misleading, because the current passed into the cell does not *accumulate*; there is no *storage* of electricity in the cell, but the current causes a chemical change in the lead oxide, which can afterwards work in the reverse direction and cause a new current.

Just as some bodies are good conductors of heat, so some are good conductors of electricity, and generally speaking, metals and other substances that conduct heat well are also good conductors of electricity. If an electric current is made to pass through a body that is not a good conductor, heat is produced. If one of those chains composed of alternate links of silver and platinum is obtainable, it should be shown, and the current that will pass readily through the silver links will make the platinum red-hot.

Note that the filament in an electric lamp would soon be destroyed unless the air were first exhausted. Some lamps are filled with a gas that will not unite with the filament.

A small voltmeter, such as is used for testing the cells of a wireless set or of a motor-car, can be bought for a few shillings and will prove very useful in demonstrating the presence of an electric current. By joining such an instrument to a coil of wire, it can be shown that a current is set up when a bar magnet is passed into the coil, or when the coil is moved across the lines of force of the magnet. This explains the production of those powerful currents which supply electric light and heat to our large towns. A *dynamo* is a machine in which large reels of wire are made to revolve between the poles of powerful electromagnets, and suitable leads are fixed to convey the current to the mains.

Generally speaking a conductor is required for the passage of electricity, but if the difference of potential is very great the electricity will leap across a space. The *magneto* of a motor-car engine is really a small dynamo, and the sparks that it produces set light to the mixture of air and petrol vapour, and the consequent explosion drives the piston forward. In the first instance the coil of the magneto has to be revolved by turning the starting handle. But just as the motion of a coil across the lines of force of a magnet will produce a current, so by proper arrangement a current passing through a coil may cause the reverse motion. A machine in which an electric current is used to cause motion is called an *electromotor*. In a motor-car a dynamo produces electricity which charges the accumulator, which in its turn can cause the magneto to work.

In the same way the electric current produced by the dynamos in the depots is used to turn the electromotors of trains and trams, and many machines in factories; the vacuum cleaners in our houses are worked in this way, and even the barber's hairbrush is often turned by electricity.

CHAPTER X

Chemistry

APPARATUS

Evaporating dishes.
Electrolytic apparatus.
Test-tubes, 4 in. by ⅝ in.
Woulff bottles.
Glass tubing.
Glass gas jars.
Glass gas jar covers.
Platinum wire.
Calcium chloride tubes.
Glass flasks.
Powdered sulphur.
Lime.
Granulated zinc.
Sodium.
Potassium.
Mercuric oxide.
Manganese dioxide.
Calcium chloride.
Potassium chlorate.
Hydrochloric acid.
Sulphuric acid.
Carbon disulphide.

Mixtures and Compounds

Take a quantity of iron filings and a quantity of powdered sulphur and shake them up together. A yellowish-grey mixture is formed, but if looked at through a magnifying glass the separate particles of iron and sulphur can be distinguished. If a magnet is presented to the mixture it will attract the iron filings, and although some sulphur will stick, yet after shaking them off and picking them up again a few times they will be practically clear. This shows that the iron filings retain their metallic appearance and their magnetic property after mixing with the sulphur. Now take a small quantity of the mixture and shake it up in a test-tube with some carbon disulphide. The sulphur will dissolve and leave the iron filings clean. If the solution be filtered and left to evaporate (in a safe place) the substance left behind will be found to possess all the properties of sulphur; it will burn and give off the characteristic fumes of burning sulphur. Here we see that when iron and sulphur are mixed, each element retains its own characteristic properties. Again, we are able to mix them in any proportion. Now carefully weigh out 56 parts of iron filings and 32 of sulphur, say 7 grammes of iron and 4 of sulphur, mix them and heat them in a covered pan over a Bunsen burner. When cool no free particles of iron are discernible in the fused mass, and the magnet cannot pick up the iron, so the iron has lost its properties, and so has the sulphur, for carbon disulphide will not dissolve it out. If now some dilute sulphuric acid be poured on the mass, a very ill-smelling gas—sulphuretted hydrogen—is given off, in place of the pure hydrogen which would be produced by pouring acid on the mixture before heating. A new substance has been formed which possesses properties different from those of the substances from which it was formed. Iron and sulphur will *combine* in the proportion of 56 to 32, but they can be mixed in any proportion.

These experiments illustrate the difference between a mixture and a compound. Thus, in a *compound*, the proportions are fixed and definite, while in a mixture the proportions may vary. A mixture generally combines the properties of its constituents, while those of a compound are generally quite different. By suitable methods a *compound* can be separated into simpler parts, and a body which cannot be so resolved is called an element. The pupils can name a number of elements and a number of compounds. One of the most abundant elements in the world is *oxygen*, which forms 21 per cent of the atmosphere, and its union with other bodies—called oxidation—is perhaps the most common case of chemical combination. Oxidation always causes more or less heat, and when the process produces very much heat we call it *combustion*, e.g. a fire, a burning candle, a gas jet. A lump of iron left exposed to the air will combine slowly with the oxygen, but the heat is produced very slowly and the iron keeps cool; but if a quantity of very fine particles of iron be thrown into the air, the heat produced turns them into red-hot sparks.

Examination of the candle flame will show that the interior consists of unburnt gas, which can be led out by a small-bore tube and burned as it issues from the end. This is surrounded by incandescent carbon, which will be deposited in the form of soot on any cold body placed in the flame. If some of the products of complete combustion are shaken up with lime water, chalk is then formed. Thus it is shown that the carbon in the candle has combined with the oxygen of the air, while the moisture deposited on a cold glass held above the flame shows that the hydrogen in the candle has combined with the oxygen to form water.

The course of general elementary science may include lessons on the composition of air and water, but other parts of the science of chemistry belong to the special science course. The following " Notes of Lessons " should prove useful in the general course.

CHEMISTRY LESSON I

INTRODUCTORY.—Refer to previous lesson on *Elements and Compounds*. The ancients thought that there were *four elements*, earth, air, fire, and water, and that all matter consisted of these in different proportions. *If this were so*, it should be possible to convert one substance into another, e.g. lead into gold, by adding or extracting some of these elements, and many changes seemed to support this view. Thus chalk is converted into quicklime by heating in a kiln, and when quicklime is wetted heat is given off. It looked as though quicklime was formed by adding the element of fire to chalk. With the help of the balance we can prove that this is not the case. Carefully weigh a piece of chalk—the round sticks of school chalk are not generally suitable—twist a piece of wire round it and heat it for some time in a hot fire. When cool, weigh it again. It will be found to weigh *less*. Evidently nothing has been *added* to it. Next weigh a small quantity of water in a test-tube and pour a few drops on to the quicklime. It soaks into the lime and heat is produced. Now weigh the test-tube again to see what weight of water has been used. Then weigh the slaked lime and it will be found that it has increased in weight by just this amount. The lime generally crumbles in this experiment, and so the evaporating dish used should be weighed with it, as it is the *difference* in weights that we want to find.

This lesson teaches us the immense importance of the balance in the study of chemistry.

CHEMISTRY LESSON II

INTRODUCTORY.—Refer to lesson on *Elements and Compounds*.

Ice and steam are different *forms* of water, and the weight of ice or steam produced from a given weight of water is equal to the weight of water taken, and when the ice is warmed or the steam cooled, water is produced and its weight is equal to that of the ice or steam taken. This is easily verified in the case of ice, and can be taken for granted in the case of steam.

The first experiment in determining the composition of water is the decomposition of water by an electric current.

Fill a glass or porcelain pneumatic trough with water, and having filled two test-tubes with water, close them with the thumb and place them in an inverted position in the trough. Into or under each pass a small platinum plate connected with an insulated wire, and connect these two wires with the wires coming from a battery. One cell is not powerful enough to produce the desired effect, and although two will do it, the gases come off slowly; it is better to use more. As pure water does not conduct electricity, a few drops of sulphuric acid should be added, but by suitable experiments it may be shown that the acid is not used up but remains undiminished. The gas, therefore, that bubbles into the tubes must come from the water. It will be seen that there is twice as much gas in one tube as in the other. When a sufficient quantity of gas has been collected, close with the thumb the tube containing the larger quantity of gas, hold it with the mouth upwards, and when you have brought a lighted paper near it, remove the thumb. The gas burns with a pale blue flame.

Remove the other tube in the same way, but instead of a lighted paper, apply a splinter of wood or a match with just a glowing spark. It bursts into flame and burns brightly. This gas is oxygen and the other hydrogen. We can illustrate the force with which they may recombine by the following experiment, and their other properties will be dealt with in future lessons.

Fill a thick soda-water bottle with water and suspend it so that the bubbles of gas from both the platinum plates will rise into it. When the bottle is full of gas,[1] wrap a duster round it and bring the mouth of it to a naked flame. The gases reunite with a loud explosion, the force of which sometimes breaks the bottle, but the duster is a safeguard against possible danger.

It causes an amusing surprise if the pupils are told that " *if they are very quiet they may hear the gases combine* ".

CHEMISTRY LESSON III—HYDROGEN

We now proceed to study more fully the two gases of which water is composed and will begin with hydrogen.

PREPARATION.—In the previous lesson it was obtained from water by electrolysis. It can also be obtained from water by replacing it by certain metals.

EXPERIMENT 1.—Cut off a piece of sodium about the size of a pea and drop it on to a bowl of water. As soon as it comes in contact with the water hydrogen is given off, and so much heat is produced that the sodium melts and rolls about on the surface. The hydrogen liberated is invisible, but if a lighted taper be applied, the gas at once catches light and burns, not with a pale blue flame, as a small quantity of sodium burns too and gives an intense yellow flame.[2]

If we want to collect the hydrogen produced in this way the sodium should be wrapped in wire gauze and slipped under an inverted test-tube or jar filled with water.

If potassium is used instead of sodium the heat produced is sufficient to ignite the hydrogen without the aid of a lighted taper. The flame in this case is violet, not yellow.

Iron may be used to liberate hydrogen from water by passing steam over red-hot iron, when the oxygen combines with the iron and forms a black coating. This is not a practical classroom experiment, but the process is largely used by gunsmiths and others, not for the sake of the hydrogen, but because the black coating formed prevents the iron from rusting.

EXPERIMENT 2.—A much cheaper and more convenient way to obtain a quantity of hydrogen is by liberating it from sulphuric acid by zinc.

Fit up the apparatus as shown in model, place a quantity of granulated zinc in the two-necked Woulff's bottle with sufficient water to cover it, and pour a small quantity of sulphuric acid down the thistle funnel. Gas is given off and bubbles will issue from the glass tube. For a time these bubbles will consist largely of air that was in the bottle when the experiment began, and form a dangerously explosive mixture. A series of these can be collected in a small test-tube and ignited at a flame. The first tubefuls will explode with a loud noise, but when they burn quietly the hydrogen is pure enough for use and may be collected in the gas-jar. When the jar is full, close the mouth with a glass plate under water and remove it.

Experiment (*a*).—Hold the jar mouth downwards, remove the plate, and thrust a lighted taper into the middle of the jar. *Result.*—The gas catches light and burns at the mouth of the jar, but the taper in the jar ceases to burn, although it may be relighted by drawing it slowly through the flame at the mouth of the jar.

Inference.—Hydrogen is combustible, but does not support combustion.

Experiment (*b*).—Fill another jar with hydrogen, and one full of air, stand the jar of hydrogen over the jar of air, remove the glass plate, and invert them so that the jar of air is at the top. After a short time test the upper jar by applying a light to it.

Result.—The contents burn, showing that the hydrogen that was in the lower jar has risen into the upper one.

Inference.—Hydrogen is lighter than air.

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[1] The platinum plates must not touch one another.

[2] This colour can be shown by holding a platinum wire with a little common salt in a Bunsen flame.

Experiment (*c*).—Replace the long delivery tube used in previous experiments by a short upright one drawn out to form a small outlet. Produce hydrogen as before, and having ascertained by testing with a small test-tube that all the *air* has left the bottle, light the gas issuing from the nozzle.

Result.—A pale bluish flame is produced which is very hot. If a gas mantle or piece of platinum wire be held in it, it will become white hot and give out a bright light. A piece of fine iron wire becomes white hot and melts.

Inference.—When hydrogen unites with the oxygen of the air intense heat is produced. The heat would be much more intense if pure oxygen were used instead of air of which only about one-fifth is oxygen.

Experiment (*d*).—Hold a cold body a short distance above the flame.

Result.—It becomes covered with mist or fine particles of water.

Inference.—Oxygen (in the air) and hydrogen form water when combined. To prove that this water did not come out of the bottle, the teacher can repeat the experiment and pass the gas through a tube containing pieces of calcium chloride, a substance which readily absorbs moisture. If the gas thus dried passes against a cold body no moisture is deposited, but moisture is formed after the gas is burned.

CHEMISTRY LESSON IV—OXYGEN

Introduction.—We have found that this gas is a constituent of water, and can be obtained from it by electrolysis, but is more conveniently prepared from some of the other substances which contain it.

Experiment (*a*).—Place a small quantity of red mercuric oxide in a test-tube and heat it over a Bunsen burner.

Result.—The sides of the tube become coated with mercury, and if the action is continued small beads of mercury will be seen. A glowing splint of wood thrust into the tube bursts into flame.

Inference.—The mercuric oxide is decomposed by heat into mercury and oxygen.

It was by this method that Dr. Priestley in 1774 first discovered oxygen. Mercuric oxide is expensive, and on a commercial scale oxygen is prepared by heating manganese dioxide or barium dioxide, but for use in the classroom it is best obtained from potassium chlorate.

Experiment (*b*).—Mix some potassium chlorate with rather more than a quarter of its weight of black oxide of manganese.[1] Put some of the mixture into a flask provided with a cork and delivery tube and heat over a Bunsen burner. The gas may be collected in jars, as shown for hydrogen. The air in the flask will come over with the first portion of the oxygen, but unless the oxygen is required to be specially pure this will not matter, as it will not be a source of possible danger as in the case of hydrogen. Several jars of oxygen may be collected and covered with ground-glass plates.

Experiment (*c*).—Take a piece of thin iron wire and twist the end of it round a small piece of charcoal. Heat the charcoal in the Bunsen burner until it has a glowing spark, then plunge it into the jar of oxygen and replace the cover plate.

Result.—The charcoal burns brilliantly, giving out great heat, and generally the iron wire will itself burn, throwing out sparks and falling in molten drops into the small quantity of water at the bottom of the jar. When the combustion is finished, pour some lime water into the jar, replace the cover slip, and shake. The lime water becomes turbid owing to the formation of chalk.

Inference i.—Oxygen combines vigorously with hot carbon and forms a gas (carbon dioxide) which will turn lime into chalk.

Inference ii.—Although iron combines only slowly with the dilute oxygen of the atmosphere (forming rust), it unites very vigorously with *pure* oxygen.

In this section the teacher should work the experiments in electrolysis and exploding the mixture of gases; the simple experiment of shaking the reduced iron in the air need not be done by the pupils. All the other experiments should be worked by the pupils, but when handling sodium and potassium, they require the supervision of the teacher, who should also strongly impress upon them the necessity of waiting until all the air is out of the Woulff's bottle.

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[1] The oxygen does not come from the manganese in this case, but its presence makes the potassium chlorate part with its oxygen more readily.

Central schools will of course be able to take a more advanced course than is here outlined.

The chemistry syllabus should include experiments on the weight of gases, leading up to the establishment of Avogadro's Law, and the combining proportions by volume; the relations of acids, bases, and salts; systematic chemical nomenclature; different kinds of chemical reactions, simple decomposition; study of the chief non-metals, oxygen, hydrogen, nitrogen, carbon, chlorine, phosphorus, and sulphur; study of the metals in general, and of a few with their chief compounds in particular.

A table of Mendelejeff's classification of the elements might be shown and a lesson given on the recurrence of their properties with regular increases of atomic weight.

Qualitative analysis forms a valuable training if based on a study of the solubility of the metallic compounds; but it has little educational value if treated as rule of thumb "test tubing".

CHAPTER XI

Equipment of the Science Room

School buildings vary to such an extent and teachers have generally so little voice in their planning and permanent fittings that it is of little use to give any general rules with regard to them; still, the following notes may be found useful.

At the end of the room there should be a large frame with the blackboard, which is best made in two sections and provided with counterpoises. Each section should be as wide as the frame will allow and about three feet high, and when lowered to the fullest extent should come behind a panelled casing in the lower part of the frame. When the blackboards are lowered there should be disclosed a part of the wall of a dead white which can be used for the reception of lantern projections. In front of this wall, but allowing sufficient room for the teacher to work, should be the teacher's demonstration bench, provided with a two-way gas tap and water-supply over a sink. Sometimes the teacher's bench is provided with a fume cupboard, but it is questionable whether it is not more of an encumbrance than use in this position. The bench should be about ten feet in length and provided underneath with drawers and cupboards.

Benches can be fixed against the other walls, and at the back of the benches can be placed the balance cupboards, unless there is ample provision made in a separate "balance room". The total number of balances should provide at least one for every two pupils working at the same time, and any one pupil should always use the same balance and feel responsible for keeping it in proper order and replacing the weights in their box after use. These side benches should all be provided with gas taps and sinks. With regard to the benches in the middle of the room, a great deal depends on whether the room can be kept solely for use as a science room. If not, the benches cannot very well be provided with sinks, and they should be of lighter construction. They can be provided with gas taps, which can be connected with taps sunk in boxes in the floor, provided with lids. The connexion is best made by flexible metal tubing, ending in a union which can be unscrewed when the benches have to be removed.

It is much better, however, to have the benches fixed, and in rows. There may be a slight economy of space and cost in having double benches that will take pupils along each side, but it is a great disadvantage to have half of the pupils working with their backs towards the teacher's bench. Single benches are certainly preferable. Benches should have a Bunsen connexion and a sink and water-tap within the reach of each pupil. The bench tops are best made of teak, owing to its power of resisting acids, and they should be occasionally rubbed over with bees-wax or Castile soap. The frames may be of pitch pine or oak, and the cupboards and drawers with which they must be supplied may consist of the same wood in front. The sinks may be supplied with stoppers so that they may be used as pneumatic troughs. A rail fixed at a little distance above the benches is often useful for suspending apparatus from. Inkwells may be kept in holes in the bench tops or in blocks which should be put in the cupboard when not in use. The drawers and cupboards under the benches should contain the apparatus for the individual pupil's use, and there should be ample cupboard room outside for apparatus for general use and for stores of material.

A good barometer should be fixed to the wall and readings should be taken every day.

If the premises are provided with electric current and the lantern is to be used in the science room, appropriate terminals should be provided at the end of the room facing the blackboard frame.

The Library

The following are recommended as suitable books to form the basis of the science section of the school library:

A. For Teachers' Use

Atoms and Electrons, Sullivan (Hodder and Stoughton).
Chemical Philosophy, Tilden (Longmans).
Electricity and Magnetism, Jenkin (Longmans).
Ether and Reality, Sir O. Lodge (Hodder and Stoughton).
Heat: A Mode of Motion, Tyndall (Longmans).
Makers of Science, Hart (Oxford Press).
Practical Physics, Glazebrook (Longmans).
Short History of Chemistry, Stern (Dent).
Sound, Tyndall (Longmans).
Science from an Easy Chair, Lankester (Methuen).
More Science from an Easy Chair, Lankester (Methuen).
Soap Bubbles, V. Boys (S.P.C.K.).
Theory of Heat, Clerk Maxwell (Longmans).
Waves and Ripples, Fleming (S.P.C.K.).
Chemistry, Parts I, II, and III, Reynolds (Longmans).
Sound, Mayer and Barnard (Macmillan).
Light, Mayer and Barnard (Macmillan).

B. For Pupils' Use

Achievements of Chemical Science, Philip (Macmillan).
Age of Machinery, Horne (Blackie).
Boy's Book of Wireless, Robinson (Cassell).
Chemistry of To-day, Bull (Seeley).
Chemistry and its Mysteries, Gibson (Seeley).
Chemical History of a Candle, Faraday (Dent).
Coal and what We get from It, Meldola (S.P.C.K.).
Everyday Chemistry, Robinson (Methuen).
Electrical Amusements, Gibson (Seeley).
Electricity and its Everyday Uses, Woodhull (Werner).
Electricity and Electrical Magic, Johnson (Oxford Press).
General Science, Elhuff (Harrap).
General Science, Thompson and Leslie (Cassell).
How it is Made, Williams (Nelson).
How it Works, Williams (Nelson).
Heat and Energy, Pye (Oxford Press).
Mechanics and its Mysteries, Johnson (Oxford Press).
Our Good Slave Electricity, Gibson (Seeley).
Outdoor Schoolwork, Feasey (Pitman).

NATURE STUDY

BY

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NATURE STUDY

CHAPTER I

Introduction

During the past two decades, our English countryside has suffered more severe changes than probably have taken place during any previous couple of centuries. It is, therefore, satisfactory that there should now be a growing and insistent demand for the introduction of biology or nature study into our schools, for, if this is properly taught, it should do much to generate and foster a healthy public spirit as regards the preservation and care of the countryside. This can doubtless most readily be done by arousing in our children a keen interest in plant and animal life, with sympathy and imagination for living things other than themselves; this should be put in the forefront of our work, and unless we succeed in this, our nature study work is a failure, however much knowledge may have been accumulated by our scholars. Associated with this should be a regard for the amenities of the countryside, its old houses, its hedgerows and trees, field and woodland paths, and all those features which make up our beautiful Britain; and hence should follow the feeling that no action on our part—for example, the littering of the countryside with paper, bottles, and other debris—should leave our rural haunts less beautiful than we find them.

The first essential, then, for a successful teacher of nature study is that he must be an ardent country-lover and an enthusiastic naturalist. In many ways it matters little what branch of natural history may form his special study—plants, insects, birds, pond life, geology—the spirit of the teaching is of far more importance than the subject-matter, and it is a matter of experience that more keen naturalists arise in a school where there is no definite biological teaching, but where there is an enthusiastic nature student on the staff, than occur in a school where nature study is taught by a teacher whose heart is not in his work. The chief object of nature study, then, is the cultivation of an attitude towards natural objects, which shall persist through life and be a never-ceasing source of happiness; it would rank, therefore, with subjects such as art, music, and literature, which add to the æsthetic joy of life, rather than with other branches of the curriculum where the chief value lies in the facts themselves or in the training which their acquisition involves.

The subject, however, has other definite educational values. The best work encourages a training in close observation, usually necessitating patience and perseverance, and courage to sustain long-continued effort to gain a desired result; it needs good powers of description in terse, clear sentences; and some skill with the pencil, either natural or acquired, is an added advantage. At the same time, it should be clearly understood that, as an experimental science, nature study ranks behind chemistry and physics. Living things are not so closely under our control as is the merely material apparatus of our ordinary science laboratories; they are affected to a large extent by external conditions of weather; they are very largely seasonal; experiments may need to be continued through vacations, and many interesting phenomena may occur at times when our scholars are not under our charge. It is probable that the best results are obtained by a teacher who has a class during the whole of its school time, and not by the specialist teacher whose lessons with any particular class are necessarily more limited in number and scattered in time. This difficulty of control of our living experimental material not infrequently disappoints young teachers, trained in the natural science laboratories of our modern secondary schools and universities, who are therefore prone to give up nature study in disgust after two or three years' trial. If, however, we recognize the difficulty in advance, we can allow for it and so not lose heart. The subject does permit of a good deal of simple experimental work in both botany and zoology, and this possesses the added advantage that, as a rule, it needs little expensive apparatus, and indeed much of it can be carried out in most homes.

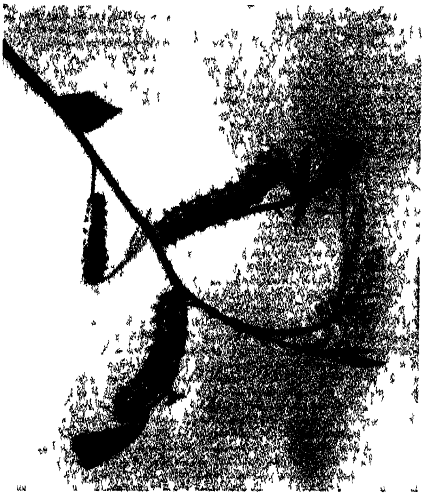
A most important aspect of the study is its preparation for sex-knowledge. It is probable that the simplest path to this is by way of the life histories of the plants, and a child who has been carefully taught the functions of pollen and ovules, followed by observations on the fertilization of frog spawn and later by observations on insects, will almost insensibly come to a knowledge of the specific functions of his (or her) own body, though it is probable that, in the present state of public opinion, the teacher should not take to himself voluntarily the position of mentor in this matter. In any circumstances he must exercise great caution.

Nevertheless, just as with chemistry and physics, the work should not be purely observational and descriptive; a considerable amount of deductive and inductive work can be done, and indeed must be done, if the subject is to have its full intellectual value. There are two dangers to be faced here. One is the danger inherent in the heuristic method as applied in schools: that we are dealing with young, inexperienced experimenters whose data are certainly very inadequate in quantity and probably only moderately accurate in quality. In most cases conclusions drawn from this material are not derived in a strictly logical manner at all, but are due largely to the guidance of the teacher. A further discussion on this subject

Ichneumon Fly in Heather

Larvæ of Privet Hawk Moth

Larvæ of Magpie Moth



Larvæ of Emperor Moth

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follows later. The other danger is the fact that in no subject are conclusions so likely to be inaccurate as they are in biology, and any conclusions drawn by the scholars need both a very careful re-examination as knowledge develops, and a recognition at the time that they are only first approximations to the truth. One need only point to modern modifications of views held with regard to transpiration in xerophytes, the necessity of cross-pollination in plants and the artifices and mechanisms for bringing it about, and many other biological hypotheses.

The Teacher.—In nature study, as in all branches of educational work, the great source of inspiration and the great factor for success is the teacher himself. He must be a constant student, always seeking to add to his knowledge and to widen his experience. In all probability at first he starts as field-naturalist, and this he must make up his mind to be throughout his career. It is essential that he be a keen observer, patient, careful, chary of drawing conclusions until he has accumulated the relevant observations, and ever ready to modify them in the light of further knowledge; and it is this power of observation that he should endeavour most of all to train in the scholars under his charge. These observations should be carefully entered in a diary which will thus give a sequence of events throughout the year, and furthermore will give a connected series of related observations. Thus, if we are recording the dates of opening of flowers, this should be done to show the general sequence throughout the months, but a second record should be made to show the first appearance of any particular kind, as coltsfoot or hazel catkins, from year to year, and this further should be correlated with the character of the weather from day to day.

It is probably wise to concentrate more especially on some special branch of study, to be determined partly by the teacher's own special bent and partly by the character of the opportunities offered by the neighbourhood. This will determine to a large extent the bias of the teaching, for the field is so large that it is hopeless to attempt to cover the whole of it in anything like an adequate manner. Thus one man uses fresh-water aquaria as the centre round which he builds his teaching, another shells, and a third butterflies and moths.

After this it will be necessary to extend one's studies as widely as possible, though with less knowledge of detail; for a competent nature teacher must necessarily know the commoner plants and animals of his neighbourhood, and be able to help his scholars along the lines determined by their own tastes. Two things will assist materially in gaining this knowledge. Despite all that can quite reasonably be said against it, the formation of a collection of specimens by a thoughtful man is a great aid to learning much of the habits and structures of living plants and animals of the neighbourhood. Large collections are not required, but effort should be devoted rather to variety and breadth. The other great aid is to join some society for the study of natural history. There are very few places of any size which do not possess such an asset, and by association with students of other branches of study than our own we acquire in time, in a pleasant and easy way, a considerable amount of very useful information. Furthermore, in many cases there are federations of such societies, or societies of wide membership, which at frequent intervals meet at places of varied character and interest, societies, for example, such as the Yorkshire Naturalists' Union, the Selborne Society, the Northern Naturalists' Union, and membership will usually be found of great assistance.

An excellent society to which every teacher of nature study should belong is the School Nature Study Union.[1] Their quarterly magazine, *School Nature Study*, contains excellent papers on matters of interest to both teachers and scholars, and copies of back numbers of these papers can be obtained separately for a very small charge.

In cases where membership of such societies is difficult, it is usually possible in time to build up a circle of correspondents in various parts of the country. Magazines devoted to special branches of natural history, e.g. entomology, ornithology, botany, are published at regular intervals and a list of some of these is given in the bibliography.

Besides the ordinary written notebook, sketches should be made whereever possible, and these should be classified so as to facilitate reference. A loose-leaf system is probably the best method of preserving them. A camera is a most valuable assistant, and with its aid beautiful records can be made of events and structures that are likely to be useful in our teaching (see p. 77).

A microscope is indispensable. For most workers a student's microscope will do all that is required, and good and cheap instruments are obtainable from many English makers. The most useful powers are 1½ in. and ⅔ in., and eyepieces multiplying by six and eight.

The worker should gradually build up a library. This will consist of three classes of books—general textbooks, those relating to his own special study, and books of more popular interest which will be of assistance in his work. A very useful *List of Books on Nature Study* (Publication No. 54), price 2½*d.* post free, has been published by the School Nature Study Union, and can be obtained from their officials; there can also be obtained from the Librarian, Public Library, Leeds, Dakin's *What to Read in Biology* and Professor J. Arthur Thomson's *What to Read in Biology*, price 3*d.* each. Other textbooks known to the writer are given in the bibliography.

It need hardly be said that it is not always necessary to buy new copies of the books. Lists of publishers' remainders should be consulted, old review copies purchased, and second-hand book shops visited on every occasion, and, in course of time, a very respectable naturalist's library can be built up at relatively small cost.

Finally, it will be well to keep a loose-leaf index and record of all important facts and papers. The writer's index is on sheets of fairly stiff paper 7 in. by 3 in., which can often be obtained for a small charge at printing works where they are rejected as " cut-offs ". These are labelled in large letters at the tops, and separate papers, facts of special interest, newspaper cuttings, &c., are either indexed or actually preserved, and by a system of cross-references, papers or accounts on any subject can be located at a moment's notice. If this is started early, its formation is gradual and is not a trial, and its value is inestimable.

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[1] Annual subscription 4*s.*, to be sent to Mr. J. W. Hamilton, 71 Pulborough Road, Southfields, London, S.W. 18.

Accommodation.—In many schools there must be a certain amount of makeshift in the provision of a room, permanent equipment, and general apparatus for the teaching of nature study; but in many large central schools, especially in new ones which may be built as time progresses, a properly fitted biological laboratory will be provided. The following description is taken from such a room which has shown its value by service.

The size of the room depends somewhat upon the needs of the school, but the one in question is 33 ft. by 27 ft. It is well lit from the south and east, though a west lighting would probably have been preferable to an eastern one. The demonstration bench runs along one end of the room, with a couple of large blackboards behind it; it stands on a platform 8 in. high. The demonstration bench and the working benches are all 36 in. from platform and room level respectively, and the latter run at right angles to the lecture bench so that the teacher can see down the working aisles. There are three working benches, the outer two being for single rows of students working to face the middle of the room, and the middle one for two rows of students facing one another; the outer benches are 24 in. wide and the middle one 42 in. wide. The working spaces are 30 in. wide. All the benches have teak tops (but this is unnecessarily expensive), one inch thick and unpolished but well rubbed. Each working place has, on its left side, two pieces of opaque glass let into the bench and tightly fixed in position; one is white and the other black, and each is 6 in. long and 3 in. wide. In addition, each working place has a drawer 23 in. wide and 4 in. deep, outside measurement. There is a double gas tap between two workers, but no water, no sink, and no bottles. The electric light pendants fall above the middle of the benches, and can be raised or lowered at will. Sinks, taps, towel rail, and bottle shelves are arranged in convenient places in the room, just as they are in any other laboratory.

A blank part of one wall is painted white for lantern demonstrations, and the windows can be darkened by means of black opaque blinds working in grooves. A plug is provided for the electric lantern lamp, and a shelf runs along one side of the room to carry microscopes.

It should, however, be understood that a room of this description, though desirable, is by no means essential, and, just as very efficient work in natural history can be carried out at home with very simple materials, so at school the provision of quite cheap apparatus will yield very valuable results in the hands of a capable teacher. For example, flat-topped tables can replace the laboratory benches, and their tops can be made of ordinary white wood well polished with beeswax. Instead of bunsens, spirit lamps of fair size form reasonably efficient substitutes for most work. The room should contain, however, at least one sink and tap, and the provision of adequate shelf space is very necessary.

A certain amount of economy may be secured by means of demonstration lessons given by the teacher, instead of class experiments. These use less material, the work is done quicker, and the lesson furnishes a good example of experimental work efficiently performed by a capable and experienced man.

Stress should be laid on the provision of good lighting at the working benches. Some at least should face and be close up to the windows, as natural light is better for most purposes than artificial light.

A very important matter in all biological laboratories is the provision of space and boxes (or drawers) for the storage of material, and there can scarcely be too many cupboards, both glass-fronted and wooden. The school described above has a stack of shelf-spaces in a large storeroom; these reach from the floor to ceiling, and each space is 40 in. wide and 13½ in. high. Expense has been saved by using cardboard boxes (readily obtained from many kinds of shops, especially outfitters and confectioners) which are stacked here. All are labelled with a number and the character of the contents, and these are card-indexed also, so that there is no difficulty in obtaining any particular object. The boxes contain seeds, dry fruits of many kinds, shells, dry moss, and all the other material which experience has shown to be necessary during lessons, and which it is frequently so difficult to get at short notice. Needless to say, the storeroom must be dry or objects will become mouldy.

An adequate supply of both narrow-necked and wide-necked bottles is a necessity. The best plan is to obtain a price-list from one of the firms who fit up school laboratories, and to add to the equipment as time, need, and financial opportunity render it possible and necessary.

A much more difficult matter than the storage of botanical material is the storage of insect specimens. The ideal method is the provision of a proper insect cabinet, but only the best equipped schools will be able to afford these. A very efficient substitute is to be found in the wooden store-boxes sold by entomological dealers; a convenient size is 16 in. by 11 in., and these cost 8*s*. 6*d*. each new. They can be bought as required, and should be stored standing vertically, as in this way mites are less likely to attack the specimens.

A very convenient store-box for insects and shells can be made from the boxes in which photographic negatives are bought. These are of various sizes, so that they can be used either definitely as store-boxes or they serve well to hold a specimen or two for examination by children without any risk of the damage to antennæ, wings, and other delicate portions to which one's most treasured specimens are exposed at school. Each box has a hole cut in the lid, the edges of the hole being ⅜ in. away from the edge of the box. The cover is made of a washed and cleaned negative glass of the size of the box from which it has come. This is fixed in position by means of *passe partout* binding paper. The floor of the box into which the insect pins are stuck may consist of soft cork carpet, to be bought at any house furnishers; this serves when a number of specimens are to be put into the box. Where only one or two specimens are to be stored, the support for the pin can readily be made of a piece of ordinary bottle cork, stuck in the correct place in the bottom by means of seccotine. A little naphthaline should be introduced to prevent the entrance of mites. If cotton-wool is put into the boxes, they serve admirably as store-boxes and exhibition cases for shells, small fossils, and many other objects.

A great plague in insect collections, especially in sea coast and other damp districts, is the occurrence of mould on dried specimens. In many cases this can be removed by gently brushing the specimen with a brush soaked in benzene. If the specimen is hard and horny, like a beetle or grasshopper, an even better medium is a solution of one part of phenol (carbolic acid) in three parts of xylol. This effectively destroys both mould and mites. Better than any method of cure, however, is prevention of the trouble itself. This can readily be done by placing in each box a piece of ordinary bath sponge supported on a long pin with a piece of cork below it to keep it in position. The sponge is moistened at intervals of about three months either with the xylol-phenol solution mentioned above, or with Calvert's No. 5 crude carbolic acid. This is quite cheap and is much more effective than the pure acid. The strictest precaution must be taken to keep these materials out of the way of children, as phenol is a deadly poison.

CHAPTER II

Scheme of Work

The great advantage of nature study courses, in elementary and central schools at any rate, is that there is no examination to be faced at the end of the course. Thoroughness is necessary, of course, but the nerve-racking strain—both for teacher and pupil—of preparing for an examination test is absent, and one can work with a freer hand and a wider survey.

If our ideas as to the object of teaching nature study are correct, the subject quite naturally divides itself into four main branches, which are, of course, closely interwoven one with another. These branches Professor J. Arthur Thomson has very aptly called the *Drama of Life*, dealing with all the wonderful phenomena associated with structures, functions, and life histories; the *Unity of Life*, teaching of the intrinsic one-ness of the life functions of plants and animals; the *Continuity of Life*, which deals with all the matters associated with sex-structure, sex-relations, and the preparation for the next generation; and the *Web of Life*, which has to do with the play and interplay of organisms and their multitudinous reactions one on another. Consequently every syllabus which aims at teaching the subject in a worthy manner must, during its development from season to season, consider all these aspects, even though it be in only a very elementary manner; and if this ideal is kept carefully in view, it will prevent undue insistence on pure morphological work on the one hand, and of too close a study of functions or of habits on the other.

A carefully drawn up syllabus is an absolute necessity in a subject like nature study, for logical continuity is far less obvious than in the experimental sciences such as chemistry and physics, and without it we are prone to work in a hand-to-mouth manner, depending on the acquisition of material for the character of each lesson as it comes. There is, however, nothing sacrosanct in a syllabus, and though we urgently need it, we should use it as a thing of great plasticity, its content depending on a variety of factors.

It is probable that the only person who can draw up a reasonably satisfactory syllabus for a course of nature study is the teacher himself. The first factor is his own predilection, and it is certain that along these lines he will work with most joy, energy, and enthusiasm, and will inspire the same feelings in his scholars; they will to a certain extent follow the same trend of work, but the better workers will speedily find their own bias, and will follow it to their own satisfaction. Then again, in the same connexion, much will depend on the teacher's aims, both temporary and ultimate, and it will probably be advisable to modify the syllabus at intervals so as to treat of a different series of phenomena or to consider the same phenomena from a new angle; this tends to intellectual freshness on the part of the teacher, and prevents him from getting into a groove. The second factor is the age of the children. Nature study can be very satisfactorily taught to children of seven just as to those of fifteen. In the writer's school, the course for the young children is purely preliminary —to give a liking for a country walk, to show some of the interest of the countryside, and to give some simple exercises in observation; thus the field excursion forms the basis of all the work, and laboratory work is altogether absent. On days when it is impossible to get out of doors—and there are surprisingly few of these—the lesson is dropped altogether and another subject substituted—to the boys' intense disgust! This observational side of the subject is further stressed for some years, although as the boys get more command over pen and pencil, laboratory work becomes more important; and finally, reasoning from observed facts to conclusions, and from conclusions to possible further observations, takes its place in the course, becoming more and more exacting as the age of 15 is approached.

Another important factor is the character of the district, combined with the future careers of some of the boys. In a coast district, marine work can take its place in the curriculum, although in most schools it will be absent. In a mining district, geology of a very simple kind can be studied with profit and pleasure, and in almost all districts pond life will form an important part of the curriculum. In a purely rural area, nature study is a very important subject and should be linked up with gardening and with the important agricultural pursuit of the district.

Associated with this is the type of the school itself. When the children come from poor homes, where overcrowding is probably rife, very little if any work can be done by the boys away from school, but in proportion as home circumstances are better, more can be expected in out-of-school activities, and it will be found that many boys will provide themselves with simple apparatus and will form little museums of their own.

A further most important question is the length of time that can be allowed to the subject. With the youngest children, to whom the subject is taught purely by observations during excursions, a double period of about 80 minutes in all is necessary, and in cases where the school is far removed from the country it will be a convenience if a whole afternoon can be granted. (The afternoon is better than the morning because it is not necessary to get back strictly to time, and because young people are prone to be sleepy after a spell in the open air.) As this is, perhaps, rather a long time for one subject to claim in the time-table, compensation may be made by taking this lesson at fortnightly intervals, the alternate weeks having an alternative time-table. For senior scholars, four periods a week is a reasonable time to be assigned to nature study; these should be of about 40 minutes each, and it will be very convenient to have one double period, which can be utilized for outdoor work when possible, and two single periods to be devoted to classroom studies.

It is utterly impossible to plot out in advance what lessons shall be taken on any particular day. So much depends on the weather, the abundance or scarcity of material, and the totally unexpected luck of events and so forth, that the syllabus must be very plastic, and the teacher must have sufficient knowledge and sufficient resource to be able to modify his work if circumstances render this advisable. It is, therefore, difficult for any outsider to say definitely what should or should not be included in a course.

Juniors, 7–10 years

Very simple field work. This consists of recognition of some of the common trees in both winter and summer: (*a*) deciduous—oak, beech, ash, sycamore, birch; (*b*) conifers—pine, spruce, and larch. Simple means of fixing their characters in the memory are used, such as would appeal in any way to young children, e.g. the lissom twigs of the birch and their use for corporal application in schools of the olden time; the beech, with outstanding branches from the general outline of the crown so that it looks as though it hadn't " brushed its hair "; " witch's broom " on the birch, and marble galls, oak-apples, currant and spangle galls, and acorns on the oak; the colour of the buds; the tough bark of the birch and its use in making birch-bark canoes; spruce for Christmas trees. Little mnemonics are utilized if possible, and the young people are keenly interested in these devices for aiding memory; for example, they usually remember the interesting alliteration that pine needles come out in pairs, spruce needles singly, and larch needles in large numbers.

The recognition of the commoner wayside plants, e.g. the two plantains, knapweed, coltsfoot, dandelion, hawk-weed (these three form an interesting exercise in very elementary discrimination of somewhat similar plants), lesser celandine, the three buttercups, &c.

Recognition of the commonest land and sea shells, e.g. the garden snail, the banded snail, limpet, mussel, periwinkle, dog periwinkle.

Elementary work in recognizing some of the commoner insects, e.g. the common white butterflies, meadow-brown, small heath, common blue and small tortoise-shell; ladybirds (the spots are counted and an elementary division attempted), weevils, especially the diamond weevils; burrowing bees.

Recognition of some of the commonest marine animals and plants: e.g. star-fish, anemone, bladderwrack, ribbonwrack, coralline.

Middle School, 10–12 years

Here work becomes to a much larger extent an affair of the classroom as well as of the field. Easy morphological work is done involving simple dissections, and application is made of observations and preliminary conclusions drawn from them, such as, for example, the reaching of a plant towards the light, and the visits of insects to flowers. A few life histories are worked out in their main outline, and an attempt is made so to round off the course that, even if no more nature study is taken during the school life, at least an outline knowledge of general life phenomena has been gained. Consequently, although the age period suggested is from 10 to 12, the same syllabus can be used, with, of course, a treatment appropriate to the age of the scholar, for almost any two-year period in the school curriculum.

A. 1. Some simple flowers: wallflower, buttercup, sweet pea, pansy, daffodil.

Simple names of the various parts, and experiments to show their uses. If time permits, other similar flowers can be dissected so as to give some elementary ideas on classification.

2. Some common " seeds ", e.g. bean, pea, maize grain, sycamore.

3. Germination of these seeds. This can be done both in soil and in glass observation pots. Special attention to the method of emergence of radicle and plumule, to the course of development of these two, and to taproot systems and fibrous root systems.

4. Stems and green leaves. This includes work on (*a*) woody twigs such as sycamore, ash, horse-chestnut; (*b*) herbaceous stems such as wallflower, nasturtium, sweet pea.

Simple observations on arrangements for obtaining light. (*a*) Leaf mosaics. (*b*) Phyllotaxy in a few simple cases, e.g. sycamore, ash, oak, beech. (*c*) Rosettes. (*d*) Upright leaves.

5. Climbing plants. Simple observations in the field on various methods by which plants rise to the light, e.g. cleavers, rose, bramble, bryony, honeysuckle, vetch.

6. Positions and structure of buds, e.g. Brussels sprouts, horse chestnut, sycamore.

7. Character and origin of fruits. The structure of a few common fruits, e.g. plum, gooseberry, apple, strawberry.

8. Simple observations on the dispersal of seeds and fruits.

GREATER BINDWEED

KIDNEY GALL ON WILLOW

PUPA OF PUSS MOTH IN COCOON

9. Roots—structure as shown by a carrot.

10. The structure and character of a tuber (potato), corm (crocus), bulb (hyacinth or onion).

11. Flowers and their insect visitors based on field observations: some simple device for bringing about cross-pollination, e.g. primrose, pansy, gorse.

12. Recognition of common trees in both summer and winter by their leaves, buds, bark, branching and general form.

13. Simple work on the difference between monocotyledonous and dicotyledonous plants, e.g. seeds, leaves, venation, root-systems, flowers.

B. 1. Life history of a frog and toad. Comparison of the adult animals.

2. Simple work on the keeping of aquaria. Observations on Dytiscus, water boatman, water scorpion, caddis worms, dragon-fly larvæ, newts, sticklebacks.

3. The simpler work on the structure of an insect as illustrated by a cockroach or ground beetle.

4. Life histories of a few common insects; white butterfly, garden tiger moth, small tortoiseshell butterfly, dor beetle, leather jacket.

5. The differences between butterflies and moths.

6. The recognition of some common birds by their dress and their song, e.g. blackbird, thrush, robin, starling, chaffinch, house sparrow, wren, rook, jackdaw, yellow-hammer.

C. 1. Elementary work on shore life. (*a*) Some of the commoner seaweeds; e.g. wrack, dulse, sea-bootlaces, coralline. (*b*) Some of the commoner animals; e.g. molluscs, anemones, star-fish, sea-urchins. (*c*) Some of the differences between bivalve and univalve molluscs.

D. 1. Very simple geology of the local rocks and local surface features. This involves observational work on stratification, false-bedding, a few of the commoner fossils, and some of the conclusions that can be drawn from them.

2. An examination of the commoner pebbles on the beach, and conclusions to be drawn from these.

N.B.—In many localities, either *Section C* or *Section D* or both must necessarily be omitted, and the time can be devoted to further observations in either botany or zoology.

Upper School, 10–14 or 11–15 years

This is the ideal course, in which it is possible to develop a full scheme, and to give some sort of elementary but moderately comprehensive survey of the field of nature study which is likely to be of interest and value to the ordinary man or woman who does not need it for professional purposes. The principles on which the course has been built up are as follows:

(*a*) To treat botany and zoology each term as different aspects of related life processes.

(*b*) To commence with those subjects which are most likely to be of interest to the young, and gradually to extend the field of study to other branches which are, perhaps, not quite so appealing in their nature.

(*c*) To start with purely observational work, and gradually to introduce work involving, more or less, the reasoning powers.

(*d*) To take subjects which can in a large measure be studied experimentally by children in their own homes.

(*e*) To have a final year of recapitulation with the object: (i) of revision pure and simple; (ii) of introducing further allied or more difficult examples; (iii) of application of later principles to earlier studies.

It will be understood, of course, that length of terms, weather conditions, and a host of other factors may modify to some extent the order of the syllabus, while it is still retained intact in its main principles. The course can be used as a four years' course, either for a senior school starting at 10 or 11 years of age, or for a secondary school for the School Certificate Examination; it is more or less suitable for all such examinations, though it would need a certain amount of modification for the London University syllabus.

FIRST YEAR

Autumn Term.—1. Study of a few flowers to be obtained in autumn; e.g. stock, wallflower, or other crucifer (this forms a very simple and suitable example for preliminary work on floral structure), snapdragon, garden nasturtium, sweet pea.

2. Leaf-fall—very simple work on the processes associated with this. Bud positions. Practical work on skeletonizing leaves, and the formation of a small collection of typical examples.

3. Bulbs and corms as illustrated by crocus, montbretia, snowdrop, hyacinth, onion. Practical work on planting.

4. Breeding autumn caterpillars, e.g. garden white butterflies, ermine moths, privet hawk.

5. Winter sleep of plants, e.g. trees, different methods of perennation adopted by garden plants, such as bulbs, corms, underground stems, seeds, &c.

6. Winter sleep of animals, e.g. frog, toad, newt, slugs and snails, hedgehog, insects.

7. *Excursions.*—Observations on autumn fruits, change of colour of leaves. leaf-fall, deciduous and evergreen trees, autumn insects and birds.

Spring Term.—1. Trees in winter. Recognition of common trees, e.g. oak, ash, elm, sycamore, birch, beech, pine, larch and spruce, by their branching, bark, buds, general form. Collection of twigs.

2. Structure of buds as illustrated by Brussels sprout, horse chestnut, sycamore.

3. Familiar "seeds", e.g. bean, pea, acorn, sycamore, vegetable marrow. Their structure and the uses of the different parts.

4. Germination of these seeds in garden soil and in observation jars. Method of emergence of radicle and plumule. What happens to the cotyledons. Characters of the first foliage leaves.

5. Further observations on the growth of bulbs planted last term. Character of the leaves and flowers. What happens to the old bulb, and the formation of new bulbs. Effect of heat and absence or presence of light on the growth of the plant.

6. Spring flowers, e.g. wallflowers, primrose, lesser celandine; snowdrop, daffodil.

7. Preparation of aquaria, and stocking with water plants.

8. *Excursions.*—Recognition of trees continued. Recognition of some common birds in winter, e.g. chaffinch, robin, starling, blackbird, thrush, rook.

Summer Term.—1. Trees in summer. Opening of buds: (*a*) indoors, as shown by cut twigs of horse chestnut and sycamore; (*b*) in the field.

Recognition of trees in summer by their flowers, leaves, and general form. Formation of a collection of pressed leaves of trees and common land plants.

2. Some summer flowers: rose, buttercup, viola or pansy. The three common buttercups (meadow, creeping, and bulbous) furnish a very good exercise in elementary discrimination of species and in drawing up a table by which they can be distinguished one from another: (*a*) by habit of growth; (*b*) by the shape of the leaves; (*c*) by characters such as the sepals and the shape of the transverse section of the flower stalk.

3. Pond life. Observational work on the life in water of tadpoles, sticklebacks, water boatmen, caddis worms, dragon-fly larvæ, Dytiscus (great water beetle).

4. Life histories of some common butterflies and moths, e.g. garden white butterflies, small tortoiseshell butterfly, garden tiger moth, burnet moths, drinker moth, magpie moth.

5. Differences between butterflies and moths.

6. *Excursions.*—The summer is so full of objects of interest that definite choice must be made relevant to the indoor lessons—recognition of common trees by their leaves and general form; the commoner hedgerow and field plants to be recognized by both leaves and flowers; the commoner insects, including the hive bee, the humble bee, ladybirds, weevils, the chief butterflies of the district.

SECOND YEAR

Autumn Term.—1. Study of soil. General characters of clay, sand, chalk, peat, loam, gravel. Character of local soil and sub-soil. Simple experiments to determine: (*a*) the proportion of the various constituents in a sample of soil; (*b*) the effect of mixing the various ingredients so as to make a satisfactory mixture; (*c*) the test of soils for acidity; (*d*) the effect of heat on soil; (*e*) the water contents of each constituent and of a soil; (*f*) the effect of water on each material; (*g*) the rate of drying of each material, &c.

Leaf-mould—its origin, effect on a soil, and final disappearance.

2. Worms in a soil. Observations of their feeding habits, and the effects of these on the soil.

3. Roots and stems. The main microscopic character of each. The recognition of unusual forms of stems, e.g. rhizomes and tubers. Potato tuber.

4. Leaves—simple characters.

5. " Seeds " of maize, wheat, and barley. Comparison with the bean seed.

6. Germination of these grains in the same way as for the bean during the previous year. The development of a fibrous root system. What happens to the various parts of the grain during germination.

7. Fruits and seeds and their dispersal. Elementary work on dispersal by animals, wind, and explosive mechanisms. Collection of bird droppings of seed-eating birds and their examination under the lens; experiments on the germination of these seed-droppings and comparison with the seeds fresh from the plant to determine: (*a*) the percentage which germinate in each case; (*b*) the rate at which they germinate so as to determine whether the passage through the bird's body has affected them in any way, either advantageously or adversely.[1]

8. *Excursions.*—If the district permits, these should be arranged so as to visit different types of soil, and so as to show some of the difficulties or facilities in working them. Revision and continuation of work on recognizing trees in winter; addition of willow, poplar, alder, mountain ash, or other common local trees. Seeds and fruits—observations on their occurrence and methods of distribution; notes should be made as to the time and rate at which brightly coloured fruits disappear from their food plants, e.g. hips, haws, holly berries, mountain-ash berries. Perhaps hoards of nuts made by squirrels or voles may be found.

Spring Term.—1. External characters of a crustacean, a frog, a fish, a common bird and a common mammal. The observations should note in particular the analogies of various organs, and their modifications to meet the peculiar needs of their owner; the mechanism for movement, breathing, and feeding.

2. Locomotion in animals. The reasons for this power of movement—fresh food supplies, capture of other creatures, dispersal as one of a family and for the sake of the offspring; escape from adverse conditions of existence.

The different methods of locomotion exhibited by the animals in (1), and the adaptation of the organs of the animal to its form of movement.

3. Trees, shrubs, and herbaceous plants. Characters of each and their relation to their conditions of life.

Types of growth and rooting exhibited by different trees, and their effect on the undergrowth, e.g. the abundant undergrowth in an ordinary oak wood, the absence of it under a beech tree and the reasons (horizontal rooting, dense shade, growth of moss), absence of undergrowth under conifers and the reasons (fall of needles to a goodly depth, their slow decay, poor light in many plantations).

4. Annuals, biennials, and perennials. Meaning of these terms, and the advantages and disadvantages of the different modes of perennation.

5. Growth of root and shoot treated experimentally to show the effect on each of

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[1] Such seeds are said to germinate quicker than seeds which have not been subjected to the action of the gastric juices.

light, water supply, gravity. This can be studied both qualitatively and quantitatively, and curves can be drawn on squared paper to show the effect of these factors on various parts of the root or shoot.

6. *Excursions.*—Observations in the field of feeding habits of as many vertebrates as possible, e.g. sheep, cow, horse, rabbit, dog, cat, gulls, rook, thrush, &c. The movement of these animals when: (*a*) walking; (*b*) moving quickly. Observations of birds in flight; comparison of the flight of common birds, e.g. lapwing, rook, wood-pigeon, gull; flight of birds in a high wind.

Summer Term.—1. Studies of reproduction and flowering plants.

(*a*) Structure of flowers—crocus, bluebell (Scilla), gorse, cow-parsnip, groundsel, dandelion, shepherd's purse.

(*b*) Simple experiments on pollination and on cross- and self-pollination. (i) Effect of the removal of the anthers, the pistil, and the stigma. (ii) Effect of the removal of the petals. (iii) Plants fertilized with (*a*) their own pollen, (*b*) pollen from another flower of the same kind; and comparison of the seeds thus produced as regards weight, number, percentage germinating: comparison of the number of flowers produced by flowers of each kind of plant.

(*c*) Observations and simple experiments on insects and wind-pollination, e.g. list of insects visiting any particular kind of flower; list of flowers visited by (i) any particular kind of insect; (ii) any particular individual insect; behaviour of insects when visiting a flower; relative depth of flower and length of insect's tongue; colour of flowers and kind of insect visitor. Observations on size of pollen grains and relation to methods of cross-pollination.

2. Life histories of certain insects, chosen from as wide a variety of orders as possible, e.g. wasp, ant, leather jacket (daddy-long-legs), gnat, ladybird, house fly, bluebottle, Dytiscus, caddis.

3. *Excursions.*—These should have relation mainly to the matters taken in the above lessons. In addition, however, the trees studied in their winter dress in the first term should now be studied in their summer dress—flowers, leaves, fruits, &c.

THIRD YEAR

Autumn Term.—1. Differences between plants and animals.

2. Cockroach. Its structure and life history. Simple dissections of the exoskeleton, which can be gummed on cards and kept as permanent records, should be made by the children. A dissection of the internal structure should be made by the teacher and shown to the children. Relation of the mouth parts to the method of feeding. Simple observations on the mechanism and method of breathing, and comparison made between them and the corresponding features in mammals and birds. By using cockroaches of different instars, a graduated collection can be made, showing the incomplete type of metamorphosis. Comparison of this with the complete type of metamorphosis as exhibited by a white butterfly.

3. Simple classification of insects, based on character of mouth parts and wing structure, and types of metamorphosis.

4. Reproduction. This should be revised in the case of the plants so as to drive home the idea of sexual reproduction, and the terms " male " and " female " organs used freely. Reference may perhaps be made to fertilization in the frog if the teacher considers this advisable, his language being carefully chosen. Beyond this, experience would seem to show that it is not advisable for a teacher to go—at least at present.

Vegetative or asexual reproduction by means of runners, suckers, cuttings, buds, underground stem, &c. Much of this can be illustrated experimentally by the use of plants in the school garden, such as mint, rose, calceolaria, violas. The children should be encouraged to do this for themselves at home, if possible.

5. Growth in plants. Response to certain stimuli, such as light, heat, food supply, water supply, gravity.

6. Seasonal change. Colour changes in leaves, leaf-fall, decay of upper parts of many plants and shedding of twigs in some trees.

7. Recognition of some common plants. Simple ideas of classification as illustrated by the Ranunculaceæ, Rosaceæ, Cruciferæ, Umbelliferæ, Compositæ. (It is not intended that these names shall be used in the class, but they may be referred to as the buttercup order, the rose order, and so forth.)

Spring Term.—1. Hydra—used as a simple introduction to interesting features of movement, growth, nutrition, and reproduction.

2. Earthworm—the simple facts of external and internal structure, and nutrition. This forms a simple introduction to sexual reproduction. Response of earthworms to external stimuli, e.g. light, earth-movement, &c.

3. Main features of animal physiology, including: (*a*) respiration—illustration by experiments with the human body, insects in a closed space, fish in an aquarium. Observations of methods of respiration in various animals—lungs, external and internal gills of various kinds, spiracles and tracheæ, &c. Uses of respiration. (*b*) Transpiration. Meaning and importance. Experimental illustrations as to occurrence, and its dependence on various factors, e.g. exercise, temperature, dryness of air, wind. (Insects form a very suitable experimental material for these exercises.) Methods of bringing about loss of water—pores of skin, tongue, spiracles. Means of reduction if necessary—closing of pores, presence of hair, &c. (*c*) Nutrition. Meaning of term. Use of food. Values of certain kinds of food. Dependence on exercise, age, temperature, &c. (*d*) Digestion. Meaning of term. Experimental illustration of digestion of starch, proteids, fats. (*e*) Excretion. Meaning and importance. Methods of excretion—skin, lungs, bowel, kidneys. (*f*) Growth. Importance. Dependence on age. Peculiar features of growth as shown by insect life. (Caterpillar weighed each day, and results plotted on a graph.) (*g*) Energy. Meaning of term. Sources of energy, and waste products produced.

4. Life history of common frog commenced. This should be so treated as to show not only the mere bodily changes, but also the main biological facts illustrated in the life history—sexual reproduction, metamorphosis, respiration of various kinds, types of feeding, &c.

5. *Excursions.*—During this term, these are less relevant to the lessons in class. Attention should therefore be drawn to matters relevant to the change from winter to spring, e.g. catkins of hazel, alder, birch, and sallow: the first growth of seedlings in sheltered places, e.g. hedgerows, and the use of seed leaves as first foliage leaves; early insects, e.g. winter gnats, early moth, March moth, brindled beauty, &c., early spring flowers, e.g. winter aconite, snowdrop, lesser celandine, coltsfoot, &c., and flowers which can be found throughout the winter, e.g. chickweed, groundsel, purple deadnettle, shepherd's purse; early farm operations, and the influence of food, rain, wind, and sun on various types of land. Observations of winter birds and the first signs of summer life, e.g. the break-up of chaffinch flocks into pairs; development of breeding colours, e.g. in blackbird's bill; departure of winter birds and arrival of summer migrants. (Some of this bird study is dependent on the date of Easter and the consequent length of the spring term, and much of it will necessarily overlap into the summer term.)

Summer Term—1. Life history of common frog continued as above.

2. Life history of some common fish, e.g. trout, stickleback; the eggs of trout can be purchased from various firms of fish hatcheries, and simple means devised in the laboratory of supplying them first with fresh water until they have hatched and then with food; sticklebacks may be reared in aquaria, and if the females are removed when the eggs have been laid and the male after they have hatched, the young can be reared in water kept well supplied with water fleas, amœbæ, crushed water weed, and the like.

3. Main features of plant physiology. (This very difficult subject will necessarily be treated in a very elementary way.) (*a*) Photosynthesis. Dependence on time or light, warmth, chlorophyll, carbon dioxide, mineral salts. Stomates and their occurrence in various parts of a leaf. (*b*) Respiration. Importance to plant as source of energy. Illustrated particularly with germinating seeds and opening buds. (*c*) Transpiration. Significance in plant life both as use and as danger. Modifications of plants in connexion with this, e.g. reduced leaf surface, thick cuticle, sunken stomates, curled leaves, hairs, &c. (*d*) Absorption of mineral matter from the soil. Experiments on osmosis. (*e*) Food of plant. Use of culture solutions and the conclusions to be drawn from them.

4. Relation of plants to their environment in: (*a*) hedges—early flowering plants such as lesser celandine, cuckoo flower, violets; climbers such as rose, bramble, cleavers, bryony; tall plants such as hog-weed, rose campion; perennial plants which gradually choke off all others, e.g. nettle, dead-nettles. (*b*) Pastures—rosette plants,

such as daisy, plantains, dandelion; linear leaves, such as grasses; tall plants such as thistles, ragwort, buttercups; climbers such as common vetch. (*c*) Woodlands—early flowering plants such as primrose, wood sorrel, bluebell, dog's mercury; tall plants such as burdock, angelica; climbers such as ivy, honeysuckle. (*d*) Ponds and streams—absence of woody tissue, e.g. Canadian water-weed; floating leaves, e.g. water lilies, floating pond-weed; floating plants such as frogbit and duck-weed; absence of stomates in leaves and power of absorption through the whole leaf surface; linear leaves so as to give more leaf surface, as in water milfoil and mare's-tail; ease of vegetative reproduction, e.g. Canadian water-weed; different shapes of leaves as in water crowfoot.

5. Some of the commoner grasses to be recognized in a simple way, e.g. cat's-tail, cock's-foot, quaking-grass, annual meadow grass, &c.

6. *Excursions.*—Some of the field work of the previous term will extend into this, e.g. the arrival of summer migrants, observations of bird habits. In addition the course in ecology will provide abundant work in field observations and in collecting, naming, and pressing plants from various types of localities.

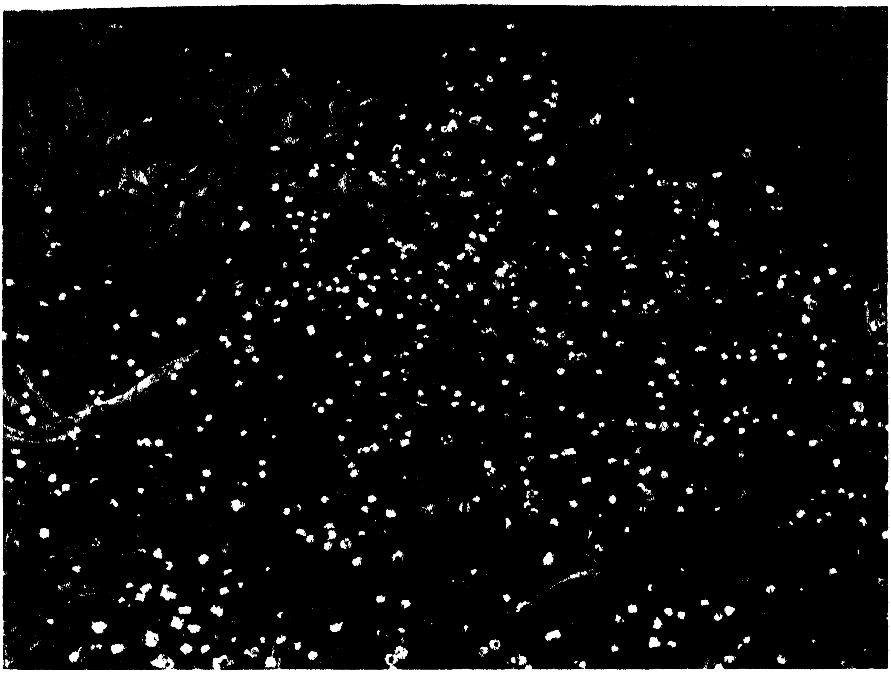
Fourth Year

As this is the last year of the course, it will be devoted mainly to revising and collating the work of the previous three years, and to the consideration of the facts from a more advanced standpoint, and particularly in their relation to ecology and phenology, i.e. the studies of the relationship of plants to their environment and to the weather conditions. Lists should be made of the typical plants that occur in suitable local habitats; e.g. arable fields, meadows, woods, gardens, moors, heaths, sand-dunes, &c.; and in each case an attempt should be made to determine the factors which enable the plant to exist in its own appropriate habitat, e.g. time of leafing or flowering, relation to transpiration, abundant and rapid seed formation, &c. For phenology, parallel columns should be kept of weather conditions and time of flowering, and when these have been carried on for a series of years, a connexion may be seen between the two. In the same way, lists of birds, of insects, of slugs and snails, &c., that are found in various habitats should also be compiled; and the relation noted between weather conditions and various time-functions of animal life, e.g. dates of arrival and departure of migrant birds, dates of first appearance of butterflies, hive bees, humble bees, and other insects, first songs of various birds, &c.

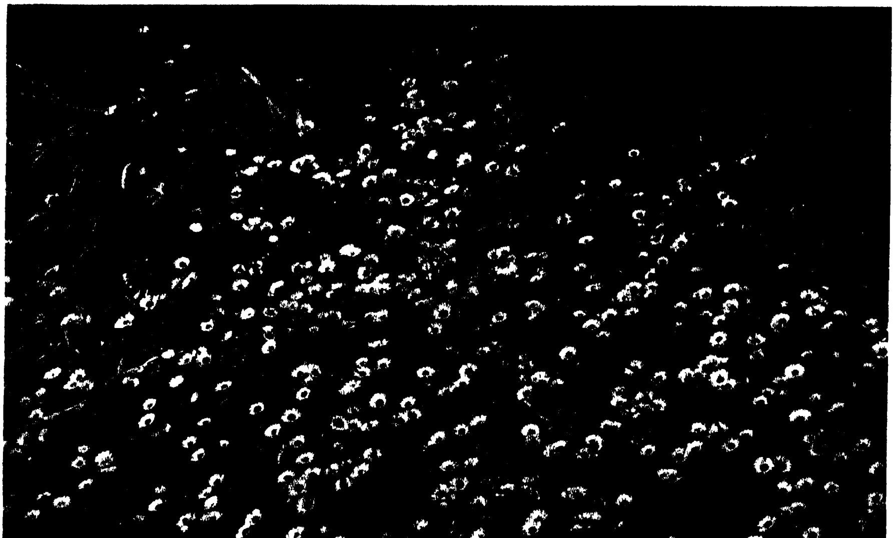
A considerable amount of interesting and valuable work can be done in the study of weeds—their recognition at various stages, the preservation of them and their seeds in a herbarium, the various kinds of adaptation they show for rapid growth and increase, their spread from place to place, and the length of time during which they retain their foothold, the succession of weeds in a recently cleared patch of land, and the various methods adopted for their destruction. In certain districts, observations may be made on the introduction of foreign plants by commerce, e.g. dock-sides, waste-ground where ships' sweepings, wool and cotton leavings, &c., have been thrown. Important sections that have been omitted should now be studied, e.g. a few of the common fungi and mosses of the district, the character of the " slime " and floating material in ponds and slow-running streams, the simple external characters of lichens and liverworts; the recognition of a few of the common insects other than those previously studied should be attempted and the life histories studied as far as possible.

The work for any individual term will consist of the summation of the work of the previous corresponding terms, but to avoid the boredom so often consequent on revision *great care* should be taken in the choice of different plants or animals for study, in viewing the subject-matter from a more advanced view-point, and in particular by correlating as far as possible structure, function, and life history and habits—in other words by making the subject a living thing with its main application in the open air and not a mere matter for the schoolroom with its pencils, books, and apparatus.

In offering the above course, the writer has no desire to say that it is the best of its kind, or that it offers the only method of entrance into the subject of nature study. Much depends on the personal bias of the teacher,



DAISIES BEFORE SUNRISE



DAISIES AFTER SUNRISE

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the character of the school, the age at which the subject is taught, the opportunities offered by the district and the distance of the school from the nearest localities which offer suitable fields of observation; and in the development of a course such as the one suggested, the subject-matter may readily be made easier or more difficult in order to fit it to the age requirements or intellectual level of the pupils concerned.

Many experienced teachers have drawn up other schemes which doubtless work well with their authors; for example, in the *Report of the British Association for the Advancement of Science*, 1928, pp. 464 *et seq.*, a four-years' course has been suggested by Miss C. von Wyss. This, however, seems to the present writer to be too difficult even for secondary schools. There is a very useful discussion on the drawing-up of a syllabus in *School Nature Study*[1] for July, 1929, and in the School Nature Study Union Special Leaflet, *Suggestions for a Scheme of Nature Study*,[1] there is a selection of schemes for various types of schools, developed from various points of view.

CHAPTER III

Specimen Lessons

In order to illustrate the way in which the subject-matter may be dealt with, two sets of notes are given, showing in outline: (*a*) A series of lessons in botany given to girls of 14; (*b*) A lesson in zoology, given to boys of 13.

The former will take several lessons to develop, and can be extended or abbreviated in accordance with the needs of the teacher and the ability of the class.

OUTLINE OF A SERIES OF LESSONS ON STARCH AND SUGAR IN PLANT LIFE

It must be borne in mind that the chemistry of starch and sugar is difficult, and no attempt should be made to deal with it except in the elementary way suggested.

1. Both starch and sugar are heated in a dry test tube. Both char, give off water and give off a gas which readily burns. *Conclusions*: Both starch and sugar contain carbon, hydrogen, and oxygen, and will yield energy owing to their combustion.

2. Both are shaken up with water. The sugar dissolves, but the starch does not. *Conclusion*: Sugar can diffuse from one part of a plant to another, but starch cannot do so.

3. Recognition that there are various kinds of sugar. (*a*) Observation of cane-sugar, grape-sugar, milk-sugar, malt-sugar. (*b*) Each kind tasted.

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[1] This costs 1*s.*, and the leaflet costs 6*d.* post free. These can be obtained from Mr. E. G. Clarke, " Craig Rossie ", Stanley Avenue, Wembley.

(*c*) Tests of cane-sugar and grape-sugar with Fehling's solution and with iodine solution. (No blue colour with iodine solution.)

4. (*a*) Observation of starch—appearance and taste. (*b*) Effect of boiling it with water. (*c*) Tests with Fehling's solution and iodine solution. (No change with Fehling's solution.)

5. Experiments to show conversion of starch into sugar by use of: (*a*) dilute sulphuric acid, (*b*) saliva, (*c*) diastase.

6. Tests of various common vegetables and other foods for the presence of starch and sugar, e.g. potato, turnip, carrot, bean seeds, onion, parsnip, rice, cornflour, wheat flour.

7. Formation of starch in green leaves.

(*a*) Preliminary test. Leaves are exposed to light, killed in hot water, decolorized with alcohol, and tested with iodine solution.

(*b*) To show that chlorophyll is needed. Experiment repeated with variegated leaf. (Starch only in green parts.)

(*c*) To show that light is needed. Leaf kept in dark for 12 hours to remove starch. Then experiment repeated with part of leaf kept in dark by means of card disc on each side.

(*d*) To show that carbon dioxide is needed. Leaf kept in dark for 12 hours. Then experiment repeated with plant in sealed glass vessel containing sticks of caustic potash.

(*e*) To show that warmth is needed. Leaf kept in dark for 12 hours. Then experiment repeated with plant in glass vessel kept in ice.

8. Utilization of starch in growth.

(*a*) Pea seeds are soaked, and put in a beaker to germinate with a thermometer in their midst; a " control " consists of soaked peas which have been raised to the boiling-point in water. The two are placed under a bell-jar. The temperatures are taken every half-hour, and plotted. The living germinating peas show the higher temperatures. Therefore heat has been generated.

(*b*) Germinating peas are placed in a jam-jar, and the top is covered with a vaselined glass plate. It is left for 24 hours, and then (i) a lighted taper is put in, and (ii) a glass rod carrying a drop of lime-water is introduced. The flame is put out, and the lime water turns cloudy. Therefore carbon dioxide has been formed.

(*c*) A hundred peas are divided into equal numbers. Half are weighed and then dried in a basin over steam for 12 hours, and then weighed. The other fifty are weighed, soaked in water and then germinated for two or three days; these are also then dried over the steam bath, cooled and weighed. The loss of weight is more in this case than with the first lot. Therefore some store of food in the plant has been used up.

Thus, during germination, seeds draw on their food reserve—largely starch, produce carbon dioxide, and liberate heat.

OUTLINE OF A LESSON IN ZOOLOGY. WHAT IS AN INSECT?

1. Show specimens of frog, fish, cat, worm, lobster, caterpillar, devil's coach-horse beetle, dragonfly. *Conclusion.* The first character of this group of animals is the existence of body rings.

2. Compare the lobster, crab, spider, devil's coach-horse, dragonfly, and beetle. Note the similarity in the character of the jointed legs, but notice also the dissimilarity of the numbers of the legs and the occurrence or absence of wings. *Conclusion.* Insects have wings and six legs.

3. Compare an ant, a beetle, a butterfly, and a dragonfly. *Conclusion.* The whole body is divided into three parts—head, chest (thorax), and body (abdomen).

4. Show the life histories of a number of insects, either by living specimens, or by preserved specimens or by lantern slides, e.g. butterfly, Dytiscus beetle, hive bee. *Conclusion.* Insects have four stages in their life history—egg, larva, pupa, perfect insect.

5. Show moth caterpillars in the same way, and point out the breathing pores. Show some of these under the microscope, as also the air-tubes (tracheæ).

Preliminary definition of an insect on the blackboard. *It has a body made up of rings and jointed legs. It carries wings, and has a body made up of three divisions. It has four stages in its life history, and breathes through pores in its body leading into air-tubes which pass all over the body.*

These ideas will need a certain amount of development later, but they are quite sound as an introduction.

CHAPTER IV

Field Excursions

Size of Class.—If the writer's ideal of nature study is a correct one, it necessarily follows that the excursions form a most important part of his scheme, and, in fact, with junior classes it is possible to conduct a very satisfactory course by this means alone.

We are here met by the difficulty that for efficient field work small classes are a necessity. The ideal number is not more than 20 pupils at the outside, and although 40 have been taken, it needs much preparation and supervision, and a good deal of valuable training in observation and deduction is necessarily lost. Sometimes a rather large class can be divided into two, part taking some other subject, such as handicraft, cookery, or laundry, which also is taught better to small classes, and part taking the excursion; later in the week or in the following week the positions may be reversed. This plan, however, suffers from the great disadvantage that the weather may throw arrangements out of gear for an excursion, and that, although an indoor lesson can be repeated in its entirety, many field observations occur but once and possibly never recur; e.g. the flight of wild geese, a chance view of a fox, mole, or squirrel. On the whole, then, it is probably best to keep the class undivided.

Materials.—Each child should be provided with a rough notebook which he can carry in his pocket, a pencil, a pocket lens which sad experience shows must be slung round the child's neck by a piece of reliable string, one or two small tubes, and a selection of tins in which he can bring home specimens intended for further study (a rather large flat tobacco tin serves well for this purpose). Note should be taken that, as far as possible, the children are suitably shod and clothed, having regard to the season, the possible character of the weather, and the locality to be visited.

Discipline.—The ideal nature study excursion is one which is a happy mean between the discipline of school and the care-free irresponsibility of a picnic, and the teacher's success in his subject can be gauged partly by the information and training, and partly by the feeling of happiness induced in the children. If he and they are keenly desirous of going on these excursions, it may fairly be stated that they are a great success in every way.

The journey from school to the day's field of operations yields a valuable training in elementary civics and human relationship, to which even young boys are very keen to respond, especially when, as is so often the case nowadays, a school cap or badge leads to a feeling of loyal responsibility. Walking—not marching—through the streets should be in pairs, each boy going with his selected chum, and conversation between the two should be permitted. Waiting for the tram or train should be orderly, children should be taught to wait until adults, and especially women, have entered, and when inside, the young are proud to show their chivalry in offering a seat to the weak; quiet conversation again may be permitted between neighbouring boys. If tram or bus tickets have been received, on leaving they may either be put into the receptacle provided, or carried home to be burnt—they must not be thrown away in the streets. Similarly, if it is necessary to eat food in the field, paper, fruit skins, and general debris should be taken back again to be destroyed. Finally, all misbehaviour and destructive propensities in the field must be sternly repressed, and boys must understand that further excursions for any individual are entirely dependent on this; entrances and exits to fields and woods should be by gates, which must be carefully closed, standing crops and farm animals must be respected, and no plant or animal may be interfered with in any way unless it is necessary for the lesson—in other words, the excursion must be such an exercise in the correct enjoyment and use of the countryside as far too many of our adult fellow-citizens need at the present time.

Field Work.—As regards the work done in the field, it is essential that it should have a definite objective; this should be either connected with work already done or preparatory to work next to be done. Hence it is necessary that there should be only a very restricted field of work, and progress must inevitably be slow and repeated revision is essential. It is, of course, much the easiest way to *tell* the children exactly what to see, but in this way the main value of the lesson is lost; so that the work must be the children's and not the teacher's, although, of course, he will be required to offer suggestions and other assistance all the time. It is very valuable to have repeated visits to the same ground at different times of the year, as by this means a much clearer insight is gained into life histories and seasonal changes, and, despite what was said above concerning the definite objective, advantage must be taken of unexpected observations, such as the flight of birds, weather changes, &c. Finally, experience shows that it is wise to restrict one's teaching to the very common things, and rarities of any kind should never be pointed out, for very obvious reasons.

Much of the field work will consist of observations only, but, when material is to be brought back, care should be observed that no more is taken than is necessary for future work, either in examination, breeding, or experiments. Young people are very prone to confine living animals in painful conditions in enclosed spaces, and this should be prevented at all costs, preferably by appeal to the child's imagination and better self—and this is usually effective—or by disciplinary measures.

In order to focus on the definite objective, the children should be provided in advance with a questionnaire. This should be written down in the rough notebook with sufficient space under each question to contain the answer. It should be relatively brief, yet not exhaustive, so as to provide opportunity for original work. In order to give some idea of the type of question that can be set, a number of questions are appended. These are intended to apply to a roadside excursion at various times of the year, and it will be seen what a large field of work is provided by apparently a most unpromising locality. For an excursion which gives about one hour in the field, it will be found that about ten of these questions are amply sufficient, and a choice can be made so as to fit in with the lessons at school. In the brackets after each question are added the answers which will probably be received.

ROADSIDE EXCURSION IN JUNE, DEVOTING ATTENTION TO PLANTS

1. What kinds of plants do you find growing on the very edge of the road itself? (Moss, grass, plantains, daisy, dandelion, silver-weed, &c.)

2. Write down a list of such plants as form a rosette. (Plantains, daisy, dandelion, thistles.)

3. Find one of these that is growing among short grass. Lift up its leaves. What do you notice about the ground underneath it? (Damper than the surrounding soil.)

4. Compare sizes and habits of the plants, passing from the middle of the road towards the grass verge. (They get larger and more erect.)

5. What do you think is the cause of this? (Less trampled on.)

6. Suggest any other difficult conditions of life that seem to you to belong to such a habitat. (Poorness of soil, insufficient supplies of water to the roots.)

7. Find two kinds of plantain. Take a leaf and flowerhead of each for preservation. How would you distinguish between them? (Narrow-leaved plantain—long, narrow leaves, short flower heads, long flower stalks, short fruit heads; broad-leaved plantain—shorter, battledore-shaped leaves, long flower heads, shorter flower stalks, longer fruit heads.)

8. Find examples of rosette plants that are growing among long grass. What difference do you note between these plants and those growing by the roadside? (The leaves are erect and not flat on the ground.)

9. Make a list of plants growing by the roadside, trying to group together those that have similar structure. (Vetch, red clover, white clover, gorse, bird's foot trefoil, &c.; creeping buttercup, bulbous buttercup; wild parsley, hog-weed, &c.)

10. Try to find (*a*) a shrub, (*b*) a tree, that has flowers like a sweet pea. (Gorse, broom; laburnum.)

11. Make a list of trees and shrubs growing in the hedgerow, and take a leaf of each for preservation. (Hawthorn, ash, elm, poplar, willow, &c.)

12. What seems to be the chief difference between a tree and a shrub? (Tree—one main stem; shrub—several equally important stems.)

13. Name any trees that are (*a*) in flower, (*b*) in fruit. (Flower—hawthorn, laburnum, &c.; fruit—willow. This depends on the locality and the season.)

14. Find (*a*) a creeping buttercup, (*b*) a bulbous or meadow buttercup. Do these occur singly or in groups? (Creeping buttercup—numbers of plants together; the other two—in single plants.)

15. Try to find some reason for this. (The runners of the creeping buttercup can usually be found.)

16. What plants seem to prefer the close proximity of the hedgerow? (Cleavers, rose, brambles, nettle, cuckoo-pint, hog-weed, &c.)

17. (*a*) What advantages, (*b*) what disadvantages, seem to belong to such a habitat? (Advantages—freedom from people walking on them, possibility of climbing, shelter from wind, &c.; disadvantages—overshadowed by hedge and other plants, which tend to get the mineral food and water.)

18. What climbing plants do we find in the hedgerow? (Vetch, cleavers, rose, bramble, bryony, &c.)

19. Write down in each case the way in which it climbs. (Vetch, tendrils; cleavers, hooks all over plant; rose and bramble, thorns, &c.)

20. With rose and bramble which way do the prickles point? (Downwards.) Why? (Less resistance during climbing, more support when in position.)

21. Cut a stalk of cleavers close to the ground, and try pulling it from the hedgerow, (*a*) from the bottom, (*b*) from the top. Which is the easier? (From the top.) Why? (Hooks offer less resistance.)

22. Which plants are in fruit? (Buttercups, dandelion, gorse, &c.)

23. Draw sketches of these fruits.

24. Gather three common wayside grasses. (Cock's tail, cat's tail, couch grass, &c.) Learn their names and take them home to press them.

25. Which trees are only just coming into leaf? (Ash, oak; dependent on locality and season.) Do you know any folk-rhyme connected with these trees? (If the oak comes before the ash, &c.)

26. Pick specimens of galls that you see. (Currant galls on oak, leaf galls on willow, nettle, &c.)

Roadside Excursion in late May, devoting attention to Animals

1. What butterflies do you see? (Small tortoise-shell, small white, green-veined white, orange tip, brimstone, &c.)

2. What kind of plant does each seem to prefer? (Tortoise-shell—nettle; green-veined white—charlock, &c.)

3. How do they place their wings when at rest? (Closely vertical above their backs.)

4. Is there any change in the positions of their wings? (Sometimes flat and separated.)

5. Can you see any explanation for this? (Flat when sun shines.)

6. Collect diamond beetles from (*a*) bushes, (*b*) nettles, (*c*) grass. Write down means of distinguishing them? (From bushes—large and with red legs; from nettles—large and with black legs; from grass—small.)

7. Note the flowers of hog-weed and similar plants, and name the insects visiting them. (Beetles, flies.)

8. Do the same with the gorse. (Humble bees.)

9. What general differences do you observe between the insects visiting the two kinds of flowers? Offer a suggestion or reason for this. (On hog-weed—little, short-tongued insects; on gorse—heavy, long-tongued insects. Associated with depth of flower and ease of getting nectar.)

10. Follow a bee and write down a list of 20 successive flowers that it visits. (Probably all the same kind.)

11. Turn over the leaves of sycamore, and note the green flies there. Have they wings or not? (Both kinds.)

12. Which seem to be the commoner? (Those without wings.)

13. Can you suggest any reason for this? (They are young which have not yet developed wings.)

14. Collect two or three pollen beetles. Examine their fore-legs with a lens. Make a sketch of this. (Flattened, and toothed along outer edge.) Of what use do you think this is? (Scrapes pollen together.)

15. Do you see any insect burrows on the path? What insects are connected with them? (Bees.)

16. Sit down beside a hole for a few minutes, and write down a description of the insect's actions. (Burrows, expels rubbish, goes foraging, brings back pollen, &c.)

17. What birds do you observe? (Thrush, blackbird, yellow-hammer, &c.) Give a simple means of identifying each kind. (Thrush—speckled breast; blackbird—colour; yellow-hammer—colour of head, &c.)

18. Examine a patch of cow or horse dung. What flies do you observe? (Yellow dung-flies.) Are they smooth or hairy? (Hairy.)

19. What beetles do you observe? (Dung beetles—Aphodius.)

20. What shape are they? (Long, rounded.)

21. Are they smooth or hairy? (Smooth.)

22. Why should they be different in this respect from the flies? (They burrow into the dung, but the flies do not.)

23. Examine their front pair of legs. Suggest an explanation for their shape. (Broad, flattened, and toothed for digging.)

24. If you see a round hole below the patch of dung, dig down to find what insect made it. (Dor beetle.) Do its characters agree on the whole with those of other beetles? (Yes.)

25. Examine leaves of trees which are fastened together. What do you find between them? (Larvæ of winter moth.) Suggest a reason for fastening the leaves together. (Protection from birds, parasites and weather.)

26. Write down a list of trees on which you find these caterpillars. (Almost all the common trees.)

27. Write down a list of other caterpillars that you see, with their food plants. (Tiger moth on nettles, &c.; magpie moth on sloe; small tortoise-shell butterfly on nettle, &c.)

ROADSIDE EXCURSION IN EARLY OR MIDDLE OCTOBER, DEVOTING ATTENTION TO BOTH PLANTS AND ANIMALS

1. What flowers do you find growing now that were not in flower in June? (Knapweed, ragwort, thistles, &c.)

2. What fruits are to be seen (*a*) on trees and hedgerows? (Sloes, blackberries, hips, haws, sycamore, &c.); (*b*) on low plants? (Thistles, hogweed, goose-grass, &c.)

3. What are the colours of these fruits? (Hips, haws, mountain-ash berries—red; blackberries—black; sycamore, goose-grass—green, &c.)

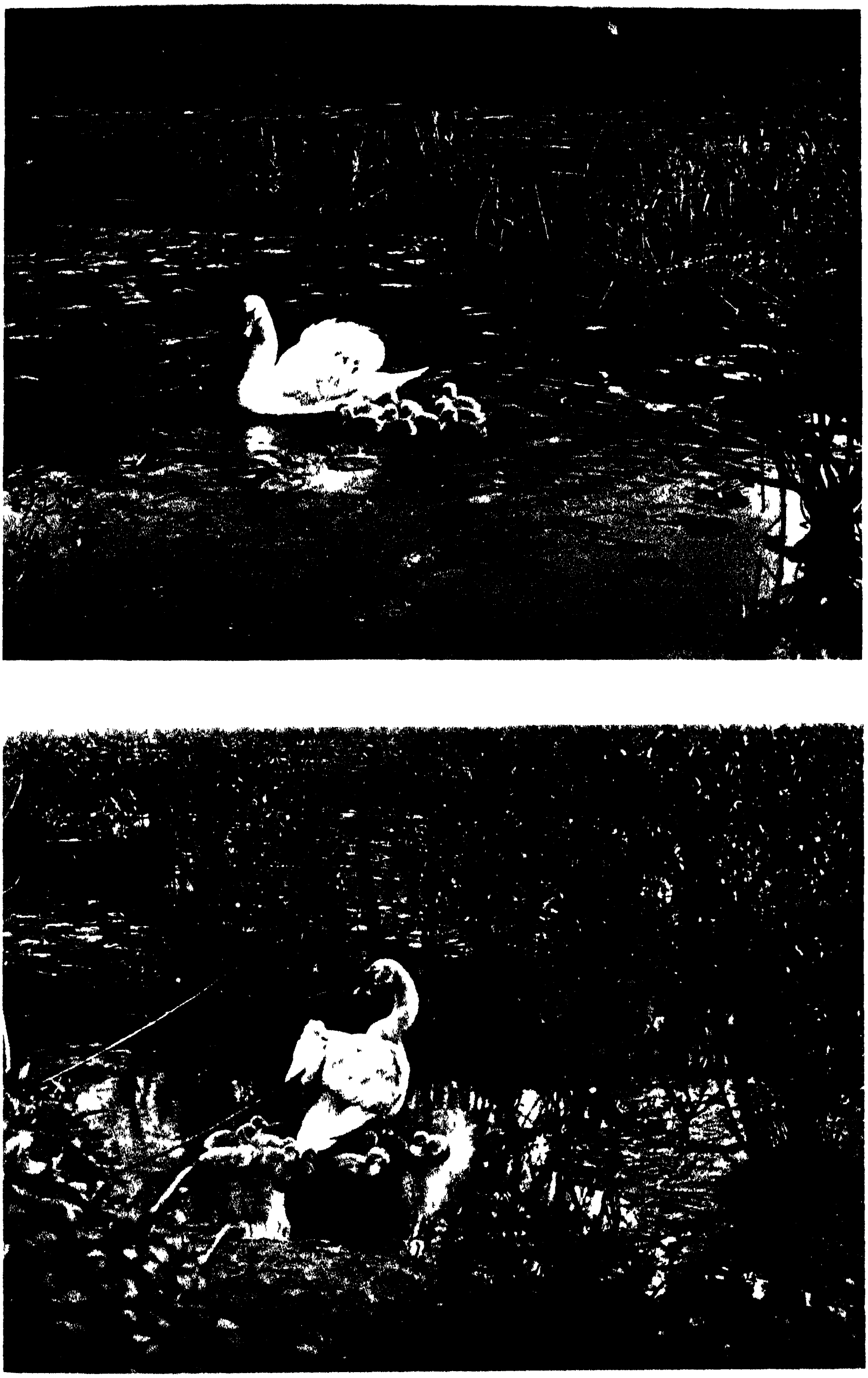
4. Does there seem to be any connexion between their colours and their softness? (Ripe red and black fruits are usually soft and juicy; others usually hard and dry.)

5. What trees are beginning to shed their leaves? (Elm, poplar, horse-chestnut, ash. This depends on the locality and season.)

6. Do you notice any difference in the methods of leaf-fall? (Compound leaves—leaflets fall; simple leaves—all the leaf.)

7. Note that buds are present on the twigs. Where does each one occur? (In the axil of a leaf.)

8. Try to recognize by its shape and general appearance the following trees. What seem to you to be the easiest distinguishing features? (*a*) Oak. (Round crown and gnarled branches.) (*b*) Ash. (Thick, stiff twigs.)



SWAN WITH YOUNG

(*c*) Elm. (Tall rounded shape with twigs on bole.) (*d*) Beech. (Twigs rising outside general outline.) (*e*) Birch. (Slender twigs and white bark.)

9. Write a short description of the bark of each tree, noting any difference between old bark and young bark. (Oak—brown and rough; ash—young bark smooth and often pale, old bark rough and dark; elm—rough; beech—smooth; birch—white when older, brown when young.)

10. What are the common butterflies? (White, small tortoise-shell, red admiral, painted lady.)

11. What seem to be the commonest flies? (Hover flies.)

12. See if you can find their larvæ on plants among green flies.

13. Make a collection of the galls you see. (Oak apples, rose bedeguar, kidney galls on willows, &c.)

This is by no means an exhaustive list of the subjects for observation along the road under special consideration, and many more questions will suggest themselves on other walks and in other localities, but it will be seen that the field excursion is really a very important method of arousing interest and causing observation; moreover, that it is essential that the teacher should visit the locality himself before he takes out his class.

Other localities which can be suggested for excursions are the coast for marine animals and sea-weeds, for geology, for birds and insects; ponds; streams, both slow and rapid; woodland—with different questionnaires for coniferous, deciduous, and recently filled woods, and for the edges and the middle portions of each; moors and heaths, grass fields, both meadow and pasture; cliffs; sand dunes and other sandy tracts; waterfalls; quarries, both sand and chalk; arable land and allotments for weeds; waste places, such as those near docks.

The class is usually dismissed in some convenient place after the excursion, without returning to school. At the next lesson, the notes are examined for each child, and there follows a general revision and discussion of the work done, during which each scholar is permitted to amend any faulty observations he has made; in particular, special attention is drawn to the significance of the observations in regard to either earlier or later work. Finally the notes are written out in the fair notebook, usually in the form of questions and answers.

CHAPTER V

General Teaching Practice

Classroom Teaching.—It must unfortunately be admitted that, whereas the teaching of chemistry and physics has in the past usually been successful in arousing permanent interest in these subjects, the teaching of biology—that is, of course, almost always of botany—has all too often only caused a distaste, sometimes amounting to active dislike. This would seem to have several reasons, the recognition of which should cause us to avoid them. The first is undoubtedly the existence of a whole language of technical expressions which, however useful they may be—and undoubtedly are—in scientific literature, are utterly out of place in a school course. When new ideas are encountered, and necessary new difficulties of nomenclature introduced, they must, of course, be tackled bravely; but in a large proportion of cases there exists some common or at least simple substitute for these technical terms; strictly speaking they may have some slight errors of logic, but in ordinary speech they serve quite well. One may instance " seed-leaves " for " cotyledons ", " stamens " for " andrœcium ", " lower jaws " for " maxillæ " in insects, " leaf-green " for " chlorophyll ", and so forth. Of course, later on, if the necessities of the students' work demand it, technical terms may be introduced, but gradually and with circumspection. A second reason for the lack of permanent interest is undue insistence on morphological work. This is often very interesting to a specialist, and is unfortunately the easiest way of giving a lesson, but, in the end, the accumulation of detail, much of it of no permanent value, drowns all interest in the subject. This is helped by the allied attention paid to classification, which used to form so large a proportion of botanical courses. Sufficient to create an orderly series of ideas is very valuable, but after that it becomes to most people a useless encumbrance.

If we wish to cultivate a lasting interest in the subject, we must first of all, of course, have a firm foundation of solid fact, necessarily simple in character but reasonably wide in survey and accurate in quality; this should have been used as exercise in training in observation and scientific reasoning. But, when all is said and done, the part that rouses the keenest enthusiasm in most naturalists is the romance of life history, whether of plant or animal, the marvellous correlation of live animals and plants among themselves and with their environment, and the wonderful drama of nature through the year from January to December; and no teacher should be considered a failure who succeeds in arousing, even though in only a few of his children, that same love of the country and its dwellers as he himself feels.

Control Experiments.—Whenever an experiment is carried out to investigate the factors which determine a certain biological phenomenon, it is the logically correct procedure to alter only one factor at a time, and so to perform two parallel experiments—one in which the factor in question is altered, and one in which it remains unchanged; this second experiment is called the " control ". Thus, in the model course of lessons given on p. 61, one part of the plant is kept in the dark, and the control is the keeping of another part in the light; in Paragraph 7*b*, one part of the plant has no chlorophyll, while another part possesses it (control); if we wish to find the effect of dissolved mineral salts on the colour of moths, the same batch of eggs is divided into two portions, and then one of the resulting larval broods is fed on affected food-plant, while the other is not (control). This method of working must be strictly adhered to, and the necessity for it insisted on with the scholars.

Accumulation of Data.—As pointed out in a previous page, most scientific teaching in schools suffers from lack of data. No one class can accumulate sufficient information for itself on one branch of work without wasting much valuable time and boring the children. It is, therefore, wise to accumulate relevant information as to a subject by a variety of choice of working material by classes from year to year. For example, if we are engaged in finding out the characters of, say, the Cruciferæ, a class one year would work with the ordinary wallflower, the next class the following year would use the Siberian wallflower, and in succeeding years the stock, the cabbage, and so forth. Each of these results would be written on the same classroom wall-sheet in tabulated form, and thus the class would get a clear idea of what is meant by saying that these plants belong to the same natural order. In the same way in experiments on respiration, transpiration, and many other phenomena, work should be carried out with different plants each year, the results being collated as they are obtained, and so the later classes could work on the evidence gradually built up by themselves and their predecessors.

Use of Textbooks.—It seems probable that the perfect textbook for nature study has yet to be written, and in fact perhaps never will be written. There are good books in various branches of the subject, particularly in botany, but most of these are not intended for young people. Two good books are Stenhouse's *Introduction to Nature Study*[1] and *Biology by Discovery*,[2] by E. Green and E. A. Potter. The best work, however, is that done by the class and teacher together. Great care should be taken that a thorough grasp is gained of the principles and structures involved. A good blackboard summary should be constructed; and then the children should be required to compose their own notes, which should be carefully marked by the teacher. The great advantage of this method is that young people will learn readily the work which they have done themselves, and with which they are more or less familiar already; its great disadvantage is that, if we rely entirely on this method, there is no standard before the children higher than that which they themselves created, and no knowledge beyond that which they have themselves gained. Despite the enthusiastic lauds of this procedure by certain upholders of the heuristic method, it seems to the writer that it is both scientifically and educationally unsound. It fails to put before the scholars a higher standard than themselves or the teacher, and they are prone to lose heart at their slow progress. They should, therefore, have access to books whenever possible, and they should be encouraged to read the many delightful books on natural history, some of which are mentioned in the bibliography.

Use of the Microscope in School.—For nature teaching, a microscope is useful, and those recommended for the teacher's use will serve admirably. For children only low powers should be used; indeed, a hand lens is good enough for most purposes.

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[1] Macmillan. [2] Dent.

If the school can possibly afford it, it is excellent to have a low-power binocular microscope: these have the great advantage that objects can be seen " in the round ", thus gaining a more natural appearance. Every child must necessarily have a hand lens. Triple combination lenses are often used, but the writer prefers a good single lens. The power should not be more than about 6 or 8: if the higher powers are used, the field of view is much smaller and the instrument is more difficult to use. In any case, experience is needed in using it so as to get the best effects. The teacher should obtain on approval specimens of different magnifying powers so as to discover for himself which best suits his purpose.

On the whole, it is best to buy botanical slides; their preparation usually involves such a lot of trouble for such a small result that the care and expense are scarcely justified.[1] Excellent slides can be purchased of the makers, and, by consulting the pages of *The English Mechanic* or *The Bazaar, Exchange, and Mart*, workers can be found who sell at a very low price. Some of the bigger firms have stocks of second-hand slides at a low price, and if the teacher gives an approximate idea of his needs, he can get on approval a selection of these from which to choose what he wants. It is well to note that mounts in fluid rarely keep satisfactorily, and for school purposes are best avoided: it is usually preferable to use fresh material in these cases.

In the preparation of zoological slides, the teacher can usually do a considerable amount of valuable and interesting work himself. Most of the textbooks give details of methods, and good general summaries will be found in Cross & Cole's *Modern Microscopy*,[2] and in Packard's *Entomology for Beginners*.[3] For years the writer has kept special note-books containing accounts of microscopic technique which have proved most useful.

Formation of Collections.—It will be noted that, in the above suggestions, the writer has definitely discouraged the indiscriminate pulling of plants or collection of insects, and he is strongly of opinion that to encourage generally the formation of collections of wild animals and plants by young people is a grave error, from the standpoints of education, moral sense, and the general well-being of the community. It encourages the destruction of living things, a habit which is strong enough in most people already, it deprives the countryside of some of its choicest possessions, and it merely creates a temporary pride of ownership in a collection of dead things which are burned at the first spring-cleaning after the child's departure from school. The only objects which may quite reasonably be collected for reference during school life are the leaves of trees and common plants, which can be obtained without harm to the plant and the common weal, and which can be preserved easily and stored without difficulty. In the odd and rare cases when a boy shows that he will most probably retain permanently a taste for natural history, the matter can be considered on its own merits, and assistance given if the teacher considers it advisable. At the same time, however, it must be understood clearly that the subject should be taught from actual material, either natural or preserved, and that the teacher himself must have an adequate supply of specimens either for class use or for special demonstration purposes. Consequently, there must be available a somewhat large collection of objects of varied character, although this collection is still most profitably composed of objects of common occurrence and not of rarities.

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[1] Full details can be found in Flatters's *Methods of Microscopical Research.*

[2] Baillière, Tindall & Cox.

[3] Henry Holt & Co.

Provision of Material.—This is probably the most worrying part of the work of the teacher of nature study. Much of the material has to be fresh, and a good deal cannot be preserved alive in the laboratory, so that it has to be obtained anew each time that a lesson is given. Each teacher must work out his own salvation in this matter, but a few hints from personal experience may be of use. In the first place, it is usually quite unnecessary—even if it is not financially impossible—to buy any of the large artificial " models " offered by the dealers; the expenditure is not usually justified by the pedagogic value of the specimens. Secondly, if the teacher has patience, a considerable amount of really useful material will come to him in time, usually without either effort or expenditure on his part, e.g. birds killed by accident, specimens of moths that have flown into houses, specimens brought up in the trawl, or shells the contents of which have been used as bait. Gifts from interested parents, and other treasure-trove will be brought to school from time to time, and can be used to play their part in the science teaching; thus have been collected heads of birds showing various types of beaks, legs of birds showing different types and different arrangement of claws, many kinds of marine shells, some of the local fossils, specimens of minerals used in local industries, &c. At the same time it is wise to remember that much material is too poor in quality to be of any value for teaching, and even a small waste box will hold more than quite a large store cupboard—it is more frequently emptied!

Much material for lessons must, however, be specially obtained by the teacher for lessons as they occur, and he should know the localities most likely to supply his wants. In some schools, the teacher receives definite periods free from ordinary school duties to enable him to go out to collect the necessary material for his lessons. Frequently, in either town or country schools, some of the children have parents whose occupations enable them to help in the supply of material, e.g. gardeners, gamekeepers, woodmen, farmers, fishermen. In the last resource, material must be purchased, and the pages of the quarterly issues of *School Nature Study* contain the names of dealers who will supply almost all the material needed in ordinary lessons.

The writer long ago gave up the use of elaborate and expensive purchased apparatus, and has carried out most of his work with the simplest material.

Vivaria.—Undoubtedly, to all young people, the most charming and interesting part of nature study work is the keeping of live animals, whether small or large; and the children should be encouraged to do this at home as well as at school, always bearing in mind the necessity of doing nothing to diminish more than is necessary the happiness of the pets.

Fresh-water aquaria are particularly interesting, they are simple to keep in good condition, and remain so for a long time. It is very difficult to make flat-sided aquaria with cemented joints that do not sooner or later—generally very much sooner—commence to leak. Very good aquaria have been made from old Winchesters from the chemistry laboratory. Occasionally these are broken at the top, and are of no more use for chemistry. The tops can readily be cut off in the following manner. A piece of ordinary glass tubing is drawn off so that, when it is connected by a piece of indiarubber tubing to the gas tap, a fine pointed flame can be obtained. A horizontal scratch is then made with a file just below the shoulder of the Winchester, and the fine flame is played on it. This very soon starts a crack, and, by carrying the jet from the end of this crack round the Winchester, it can be caused to take any course desired, and so the top can be removed. The edges of the cut glass are smoothed off with the file, and the inside is thoroughly washed out so as to remove all traces of chemicals. The bottom of the glass is filled to a depth of 2 to 3 inches with sand which has been well washed and scalded with boiling water to destroy all possible source of injury; this is covered with pebbles, also well washed and scalded. (The author has tried soil both from gardens and from streams, but with very indifferent results.) The best plants to introduce are *Elodea* (Canadian water-weed) and *Callitriche* (starwort), but many other plants serve quite well for a time. Unfortunately the plants are deprived of all mineral matter which would serve as food, so that they do not live healthily for very long. The writer has therefore, with success, tried the addition to the water of the materials necessary for plant life, and in this way the plants have lived in perfect health, and even the most sensitive animals have not suffered. The materials used are as follows:

2 grammes of potassium nitrate.
1 gramme of sodium chloride.
1 gramme of calcium sulphate.
1 gramme of magnesium sulphate.
1 gramme of calcium phosphate.
2 drops of ferric chloride solution.

This is sufficient for 2 litres of water, and must not be made any stronger or the plants will die. The plants should be introduced about a week before any animals are introduced.

Two-pound and three-pound jam-jars with wide necks can also be used, and at many stores shallow galvanized dishes can be bought cheap, which serve admirably for many creatures; for instance, the dish can be tilted on one side a little, and a Dytiscus larva which is near the time for pupation can be placed in some water in the bottom. Damp earth can be loosely packed at the upper end of the bath, and the larvæ will burrow into this for pupation. If it needs more animal food, this can be placed in the water, and the water can be changed if necessary.

For many small earth-dwelling creatures, soil is put into a large box and covered with a wire sieve also from a cheap store. The soil can be ordinary garden soil, preferably mixed with a fair amount of sand in order to lighten it. In this way earwigs, slugs, snails, millipedes, earthworms, and many beetle larvæ can be reared, in some cases from the egg to the perfect insect. It is wise with these creatures to introduce one or two large stones beneath which they can hide. For burying beetles and dor beetles a deeper box is needed, but not nearly so deep as Fabre's book would lead us to expect. An ordinary grocer's box should have the lid removed and one end replaced. If it is stood on one end so as to give a vessel about 18 to 24 inches deep, this will serve admirably. The carrion or dung and a pair or two of the beetles should then be introduced; it is necessary to put in more insects than are actually needed, because matrimony is no more inevitable in the beetle world than in the human. For olfactory reasons, these breeding cages must be kept out of doors. The front can be removed occasionally and the soil carefully scraped back so as to show the events that are taking place within.

In the Nature Study Leaflet No. 35,[1] *The Subterrarium*, Mr. Hugh Main describes a simple piece of apparatus for observing the metamorphosis of common insects. This works well, and possesses the merit that the animals can readily be observed at any time.

The devices for rearing lepidopterous caterpillars are numerous. In addition to the plans mentioned in the books, the following work well:

(*a*) The bottom can be knocked out of a tall jam-jar or pickle bottle by dropping a heavy kitchen poker into it. This is then covered with a piece of fine muslin or leno, kept in position with a piece of string or a rubber band. A piece of flat board 8 in. square has three holes bored through it with a red-hot poker. Twigs of the food-plant are pushed through these holes, which are further closed, if necessary, with a plug of cotton-wool. The wood is now rested on a second jam-jar containing water into which the twigs dip. The larvæ are put on the food-plant, and the first jam-jar is inverted over it. If the larvæ pupate in the ground, the apparatus mentioned in (*d*) must be used at the proper time.

(*b*) The twigs of the food-plant can be pushed through the hole in the bottom of a clean plant-pot, and so put over a vessel containing water. The larvæ are put into the plant-pot, the top of which is closed with muslin as before.

(*c*) The twigs of the food-plant can be pushed into a potato, and covered with the broken jam-jar described in (*a*).

(*d*) Two circles of ordinary thin tin plate are made for a small sum by the local tinsmith. They can be of any size desired, but a convenient plan is to make them of tin plate 2½ in. wide in one case and 1½ in. wide in the other, both the strips being 34 in. long; they are then bent round and soldered together to form rings. Four holes are driven at equal intervals through each of these circles by means of a pricker. Some fairly stout wire is cut into lengths 20 in. long and used to join the two circles together as shown in fig. 1.

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[1] See p. 61.

A circle of muslin 13 in. wide can be fastened down with seccotine so as to form a cover for the top (shallower) circle, and a second piece of muslin 18 in. wide and 34 in. long is wrapped round the framework, and glued to the top, bottom, and at the joint. Food-plants can be plugged into a vessel of water and covered with this frame, and if the insect pupates in earth, a vessel containing it can also be put under the cover. A very suitable substance in which they can pupate is the material in which the newest potatoes come packed.

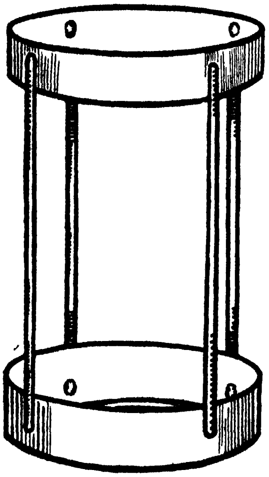

Fig. 1

Other details as to rearing, collecting, and preserving will be found in the *Young Collector*, by H. Guard Knaggs.

Relation to Chemistry and Physics.—One of the main difficulties of the teacher seeking to introduce nature study into his school curriculum is that of finding a place for it on the time-table. Chemistry and physics having proved such valuable means of intellectual training and discipline, there has developed the necessary equipment in many schools with staffs well trained in the appropriate experimental and pedagogic methods, and they are so useful in the teaching of many other subjects, including biology itself, that it is inadvisable in the extreme to attempt to oust them altogether. At the same time, biology has such strong claims also to "a place in the sun" that some compromise must be made. In most cases, this is done by taking chemistry with physics as one half of the science course, with nature study as the other. This is not the place to discuss the most appropriate syllabus for such an abbreviated Experimental Science course in itself, but it is very necessary to consider what parts of the two subjects are of most value to the nature study course. Those set out below fortunately constitute some of the most valuable portions of the chemistry and physics courses also.

CHEMISTRY.—Elementary knowledge of:

(*a*) *Air.*—Its composition and properties. The properties and preparation of oxygen and nitrogen. The nature of oxides. The other more important constituents of the air.

(*b*) *Water.*—Its composition and properties. The preparation and properties of hydrogen. Compounds and mixtures. Acids, alkalis, bases, and salts.

(*c*) *Chalk.*—The preparation and properties of carbon dioxide. Preparation and properties of lime. Hard and soft water.

(*d*) *Atomic Theory.*—Sufficient to grasp the meaning of simple formulæ and equations.

(*e*) *Sulphur.*—The element itself, its oxides and oxy-acids, hydrogen sulphide. Sulphates.

(*f*) *Phosphorus.*—Phosphates; elementary notions of their constitution.

PHYSICS.

(*a*) Exercises in measurement and weighing. The use of the balance. Specific gravity.

(*b*) Elementary work on the properties of gases. Boyle's Law and Charles's Law.

(*c*) *Heat.*—Effects of heat. Specific heat. Latent heat. Conduction, convection, and radiation of heat.

(*d*) *Light.*—Propagation, reflection, and radiation of light. The spectrum.

CHAPTER VI

Photography

A naturalist with a camera possesses an excellent medium for preserving a permanent and oft-time beautiful record of phenomena which will prove very useful for teaching purposes, either as prints or as lantern slides. In bird photography, definite instructions can be found in Kearton's books. For the photography of small creatures such as insects, the following methods have proved valuable. The camera is a quarter-plate stand camera, with double extension bellows, and a little extra magnification can be obtained by putting a Kodak photo attachment in front of the lens. Any good lens will serve, and for most purposes it should be stopped down to *f*23 or even *f*32 in order to gain depth of focus. A rough stand is made by fastening a large wooden box, with one side and the top removed, on the top of four broom-shafts. The object is held in the clamp of an ordinary wooden burette stand, which is placed on the box as a platform; this can be raised or lowered according to the size of the object to be photographed. As regards lighting, the photography is not carried out in the open air, as wind so often renders this difficult, but the writer works indoors, with the object as near as possible to a large window, open if possible. The object is placed in such a position that the light falls along it, thus throwing the details into as strong relief as possible; in the same way, it is necessary to work in a good light so as to avoid flatness of field.

A piece of white paper or a mirror is placed on the dark side of the subject so as to light up the parts in shadow. The background may be either light or dark. For light background, a sheet of white paper is held behind the object in a good light but with no shadow on it, and it is then moved about during exposure so as to avoid any sign of detail on the photograph; for a black background a piece of cardboard is covered with lamp black and placed behind the object in such a way that no light whatever falls on it. Panchromatic plates yield the best results, but any fairly rapid orthochromatic plate may be used, and these *must* be backed. Exposure is obtained with a meter, and is then usually doubled, and is further increased for a magnification of n times by multiplying by $(1 + n)^2$. The writer uses tank development, and uses as developer " Rodinal "; he finds that 12 c. c. of Rodinal per 750 c. c. of water yields a satisfactory result with Wellington A.S.C. plates and the time indicated on the temperature-development chart given with the Rodinal. In order to assist in focusing, a cross is made with lead-pencil on the middle of the ground-glass screen, and this is covered with a microscope cover glass stuck on with Canada balsam. By means of a pocket lens, the object is focused at the same time as the lead-pencil mark.

BIBLIOGRAPHY

PERIODICALS: *British Birds; Entomologist; Entomologists' Monthly Magazine; Entomologists' Record; Naturalist; Irish Naturalists' Journal; North-Western Naturalist; Scottish Naturalist; Vasculum.*

REFERENCE BOOKS: D. THODAY, *Botany—A Textbook for Senior Students*; T. W. WOODHEAD, *The Study of Plants*; AMY E. N. JOHNSON, *A Textbook of Botany for Senior Students*; F. CAVERS, *Practical Botany*; STRASBURGER and HILLHOUSE, *Practical Botany*; DARWIN and ACTON, *Physiology of Plants*; W. J. V. OSTERHOUT, *Experiments with Plants*; C. LLOYD MORGAN, *Animal Biology*; MARSHALL and HURST, *Practical Zoology*; G. B. HOWES, *Atlas of Biology*; MARION NEWBIGIN, *Life by the Sea Shore.* Excellent series of monographs of the British fauna and flora are published by Lovell, Reeve & Co., and by the Ray Society.

EXAMINATION PAPERS: G. B. WALSH, *Test Examinations in Biology*; this will be found useful for questions and also for suggestions for work along new lines.

Some valuable hints are to be obtained from the *Handbook of Suggestions for Elementary Teachers*, Chapter VI, published by the Board of Education, and to a less degree in the Hadow Report and Department Circular 904.

Most of these books are to be regarded as intended exclusively for the teacher, but children should be encouraged to read widely. Young naturalists of a past generation received much inspiration and assistance from the works of the Rev. J. G. Wood; most of these are out of print, but second-hand copies can frequently be obtained.

RURAL EDUCATION

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RURAL EDUCATION

CHAPTER I

Introduction

It is widely felt that rural education should differ in some essential respects from urban. Often it is quite simply assumed that in an urban school the curriculum should fit children for a city life, and that in a country school curriculum and methods and ideals should prepare children to live in the country and earn their living on the land. But these uncriticized assumptions have to be set on one side and careful study given to the real distinction and difference between adequate urban and rural education. All instructed and thoughtful teachers agree that school work for young children must take into account, and make constant use of, the child's out-of-school experience, whatever its nature. Thus the education of rural children at all stages, in all types of schools, should certainly have a rural basis, or, to use a term lately suggested, a rural reference.

Any economic bias to be given to a child's education must depend upon his economic future, and on this point it may be said at once that only a comparatively small proportion of children born and taught in the country ultimately pursue a rural calling, and that therefore at present it is neither necessary nor desirable that a rural bias, in the sense of an economic or industrial bias, should be given to the education of rural children, at any rate until their vocation has been more or less determined.

In spite of this fact, the difference between rural and urban education is necessarily very great, and implicates the lives of both teachers and scholars, not only within the school walls, but out of school as well.

The social setting of the country school is different from that of the town school, and the teacher's relationship to it is necessarily of a rather special nature. " The opportunities of a rural teacher," it was recently said, " lie as much outside as within the school." A modern teacher, determined to use the full resources of modern knowledge in furthering his pupils' education, will find most of his energies used up by his more or less strictly professional life, but it is impossible for those who have the instincts of citizenship wholly to deny recognition to the claims of the neighbourhood, which are usually both clear and insistent because the organization and consequently the needs of society are obvious. The rural head teacher may not feel it incumbent on him to give personal service to the village or villages for which his school caters; he would certainly be less than natural if he made no direct contributions to their social life. The first duty of the school to a community is to enrich its intellectual life, but among simple people this only takes place indirectly, through their business, their social activities and their pleasures, and all rural schools of unselected children, as well as all villages, necessarily consist very largely of individuals whose primary interests are not intellectual. The question as to the relation of village school to village society involves the question of the rural curriculum and also of the subject-matter of teaching in detail.

Before taking up the subject of the content of courses of study, it will be well to look at the broad facts about the rural school. It may be assumed that in the near future there will be two large classes of rural elementary schools: the small junior school, of children between the ages of 5 and 11, and the larger central school containing the children between 11 and 14 or 15, from several schools, but including also a junior department serving mainly the village in which the school stands or to which it is nearest. The second type of school is that with which this article chiefly deals.

This latter class of so-called "senior central" schools will fall into two sections—one, of those whose senior departments serve two, three, or four villages, most of which will still be small schools of from 80 to 200 pupils; and the others serving a country town and perhaps also one or two villages, and containing as many as three or four hundred children. It is very important to realize that large numbers of even the senior central schools will be relatively small.

The duties of the headmaster of a senior central school with a junior department will be very varied and proportionately interesting. The basic knowledge which will enable him to adjust his school to the community or communities to which it belongs is knowledge of the villages, and more intimately of the homes from which his children come. The nature of the farming carried on; of other industries, whether quarrying, factory work, or home industries; the wages paid; the probable destinies of his children; the institutions, religious, educational, and social, of the village—should all be known to him.

The opposition to the centralization of village schools is in part due to the varying traditions held by neighbouring villages and the recognition of such facts by villagers: the first duty of the head of a centralized school is to see that his school is a channel for the conduct of the better rural traditions.

CHAPTER II

The Future of the Rural Child

The subjects taught and methods used in rural schools must depend largely upon the answers to two questions: how and where are the children going to spend their post-school lives? What is the nature and degree of their intelligence? It will be seen that there is no single, general answer, true of all types of rural village schools.

The first of these questions has a very close bearing on the question of the rural curriculum, on the old and vexed question of the bias of school studies. The number of children proceeding into agricultural and other typically rural avocations varies from school to school, from decade to decade. The assumption that a majority of children proceed to rural work is definitely mistaken; with the possible exception of a very few villages where a rapid extension of market-gardening is proceeding, less than 40 per cent of the boys go on to the land, and a still smaller proportion of the girls remain in the country. For many of the boys who become agricultural labourers at 14 the work is a blind alley, and they get other work at 16 or 17.

General information on this point is of very little use; but local information is not difficult to get. Any head teacher can easily make and analyse a record of what has become of the children who have left school in the last ten or twenty years. It would be easy for a county authority to compile tables for its whole area. The following record for a single somewhat remote village (quoted from *The Country School*) shows that rural education is not entirely a rural problem:

> " . . . Of 41 boys who have left the school in the last twenty years . . . 25 went on to the land at the age of 13 or 14, of whom 3 ultimately emigrated, 6 were killed in the war, and 5 entered, later on, other kinds of employment. Of the others, 3 became gardeners, 1 went on to the railway, 2 became motor mechanics, 1 a farm mechanic, hiring out his own machines, 1 a butcher, 1 a paper boy, 1 a house decorator, 2 assistants in village shops and post offices, 1 a teacher, 1 a missionary, 1 a bricklayer's labourer. . . .
>
> " . . . 47 girls left school in the last 20 years. Of these 34 went into domestic service, 3 took to agricultural work (milking, &c., on their fathers' farms), 5 did domestic work at home, 2 became typists and clerks, 1 a dressmaker, and 1 a cook at a tea-shop. Only 2 have so far married agricultural labourers, nor is there any reason to suppose that many others will."

Such figures as are available do not give any very positive leading with regard to the curricula of the schools, but it is clear that vocational training has no place in the majority of schools. It should be given when the child has more or less chosen his vocation, or at any rate in institutions with vocational training as their professed aim. Thus, in so far as agriculture is taught in rural primary and unselective senior schools, it must be as a cultural subject, or as affording training in fundamental technique necessary to everyone. That it is a cultural subject there can be no doubt. It is one of man's fundamental and original occupations; and to understand its significance is a basis for a knowledge of economics, a knowledge of the modern world; to understand its processes is to have a good grasp of the nature of the material and organic world.

Leisure.—A fact that must not, at this date, be lost sight of, is that training for leisure is now necessary for the agricultural as for other workers, and for all grades of agricultural worker, farmer as well as man. The farm labourer's hours are now usually about 49½ per week; Saturday afternoon and evening and the whole of Sunday are now in many cases his own. Work bears heavily upon the smallholder, but he has periods of enforced idleness owing to wet weather and unworkable states of the soil. His work tends to be seasonal and there are some relatively slack periods. Most country households have wireless, a weekly and often a daily paper, and all country young people their outings to the neighbouring town, with in some cases frequent visits to the cinema. The county libraries are now very freely used, and in some country cottage homes several books a week are read in the winter.

Community Life.—Closely allied to training for leisure is training for community life. The village community is of the greatest importance historically and economically, and its life is of great value in the lives of villagers. It is to some extent in danger from extended and cheapened communications, but these, with other developments, may just as well make contributions as deductions from village life, if the people have social habits and a conception of the nature of community life.

In some of its aspects, community life is the life of leisure, so that naturally the subjects contributing to the one in some cases contribute also to the other. Dance, drama, and singing are among such subjects; these should all have been part of the heritage of the English country child, but historical circumstances have brought it about that they must be the gift of the school, if the children are to have them. Singing has been in the past the school's only music; but that should not be the case now; the gramophone and the wireless should both contribute to the children's knowledge and experience. The children should become familiar with the names and the simpler works of the great composers. It should be remembered that success in these three subjects should be gauged by the extent to which the community spirit is generated rather than by more technical standards, for music, dancing, and plays can rouse and satisfy the social impulses. The subject-matter here should always be as good as possible, but the abstract best may not be the best for the children.

But the subject of games should be treated with music, dancing, and drama, for the social need of them in rural communities arises from the same causes. An intense individualism often arises from the conditions of working and living in rural communities, and these sometimes produce extreme and not altogether desirable forms of individuality. The school ought to provide some corrective or at least to lay some preliminary foundations for social activity. These are best laid in activity itself, rather than in any forms of instruction directed to the end in view. Team games for boys are specially needed, and all opportunities of providing collective or team games for girls should be taken. By means of a selection from the subjects of group or team games, music, dancing, and drama, every school should give scholars collective activities which will develop a group or team spirit and the appreciation of collective activities in both boys and girls.

CHAPTER III

Intelligence of Country Children

Practical experience of rural children indicates that it is a mistake to regard the country schools either as a reservoir of undeveloped, undiscovered talent, or as necessarily containing pupils less intelligent than those of town schools. Schools vary in this matter from village to village. The variety in the children's minds as between one village and another depends not only on innate gifts, but upon the conditions of life. It is admitted that the mental tests are not yet devised which can be relied upon to test native intelligence quite apart from acquirements; and it will be a problem of especial difficulty to make tests which are of equal efficiency with all rural classes. A most marked difference will be found, for example, between the children of a small school in a village where the land is divided into a few large farms, and the large village of small holdings or market gardens. It is possible to find schools in villages of the former type almost all of whose pupils seem backward; where the school never, or very rarely, wins a scholarship, and could scarcely at present be expected to. In the second type of village mentioned the pupils are of a considerable range of ability, but the majority could be described as intelligent children. The difference between them is to a great extent one of attitude or state of mind; in the former there is lack of curiosity and of steady purpose; in the latter, interest and ambition. It seems unlikely that innate intelligence is the sole underlying cause of this; for it is possible to be backward as compared with the attainments and rate of learning of other people and yet not to be dull of mind. Sociological and physical factors seem, on the face of it, to have their importance. About 10 per cent of country children are ill-fed, and the class of agricultural labourers is a depressed one; there is little prospect at present of a young man in this work either earning a good wage or attaining a position of any prestige.

It is a fact of much interest and stimulation to teachers that school conditions are of great importance; perhaps in rural areas they have a larger proportionate importance than in urban. Schools containing retarded children, unable apparently to learn to read, change their staffs, and in a few years, though the families of the village are unchanged, the proportion of " dull and backward " children is much reduced. Children dull in school are found to be knowledgeable and able in out-of-school affairs. The results of such tests as have been given by psychologists are not disconsonant with practical experience.

The Report of the Mental Deficiency Committee (1929) shows that the incidence of mental deficiency is higher in rural than in urban areas, the figures being 39·7 and 20·9 per thousand respectively, for children between 7 and 14. We must expect to find also that there is a higher percentage of educationally defective children in the country, since there is every reason to suppose that mentally defective and retarded children are not merely contagious groups; there is scientific ground for thinking that a causal relationship exists between them. The number of children educationally retarded but not innately defective is unknown; but the Committee gives a long list of environmental causes of retardation all of which are active in the country as in the town.

The teacher then may expect to find a somewhat higher proportion of defective and backward children in the country than in the town on the whole; but he may be especially fortunate and find none in his school.

In the larger schools which contain centralized senior classes, the headmaster will certainly have the problem of providing training for backward pupils, whether educationally defective or only retarded. Where possible, mental tests should be added to the other means for discovering to which of these classes a particular child belongs. Few suggestions can be made here as to the training of either of these classes; but they should be allowed some choice of occupation, and encouraged to follow up those in which they are successful, rather than forced to take the whole curriculum; great care should be taken to afford encouragement, to keep the children's minds in good tone. For example, a child who can read fairly well, but is very poor at arithmetic, may, perhaps, be kept in a higher class for most subjects, but sent to a lower for arithmetic. Sometimes, though not always, retarded children find simple handwork more satisfying than the rest of school work. It should not be forgotten that emotional defect does not always accompany every form of intellectual defect, and that backward children are sometimes very responsive to music and other forms of art.

Finally, it should be mentioned, a teacher going from urban to rural work should not be misled because of the fact that urban children have " greater verbalistic ability " than country children. This characteristic accounts often for the apparent stolidity of country children. In some homes and schools the fault is more than corrected, in respect of written speech, by much reading, but only an early start in the infant school can correct it in the case of oral expression.

Where dialect is strongly established and the language of the home is not that of the school, allowance must be made for the fact, especially in the case of the younger children. In some rural areas the difference between the language of the homes and any " standard " English is very marked: and some children suffer the same kind of disabilities as those in bi-lingual countries, who as infants are taught the native tongue, but at school are taught the " official " language. Transfers from reading to speech are not easily made by some children under these conditions, and special training in speech may be necessary. Some teachers of long residence or, perhaps, having their origin in areas of strong dialect, adopt the dialect or a modified form of it for a part of their teaching purposes. This is not to be recommended, but it cannot be doubted that a teacher who knows the dialect of the district, and its relation to standard English, is able to assist scholars to make transfers from the dialect to English, and thus to teach more rapidly and effectively. Where dialect is most strongly marked it may be necessary to use methods somewhat similar to the simplest oral methods used in the teaching of foreign languages. While a boy or girl may learn a certain amount of most school subjects whilst using the local dialect, the scholar who leaves school without any facility in standard English often labours under a lifelong disability.

CHAPTER IV

Staffing a Rural School

If the rural school is to relate its work to the needs of the community it serves, its staff must be specially equipped to this end. It is often thought that the manual and scientific subjects are the best qualifications for rural teaching, but the need for these is subsidiary to the need for a humane and liberal outlook, and the power to study and appreciate the human material with which the teacher has to deal, and the social circumstances and historical movements which have made it what it is.

It is essential that the head teacher should have a social outlook, and a wide and deep interest in education, since he must give the school its direction, determine its mode of discipline, and its more general methods. In other respects he may hope that, in time, his staff will supplement his accomplishments and supply his failings to some extent. Every rural teacher needs to be an accomplished person in several directions. No rural schools, even in country towns, will be large enough to permit of a high degree of specialization; of the 12,000 rural schools some 6000 at least will contain less than 150 scholars, even after reorganization, so that a rural head teacher may well find himself the captain of a crew of 3 or 4, while many women certificated "head" teachers will find themselves alone or with one assistant.

We may take first the case of a headmaster with a small band of assistants. His own qualifications must include an interest in all school subjects; in small schools with uncertificated teachers among the staff, it will be essential for him to be capable of drawing up schemes of work in all subjects, as a high proportion of uncertificated teachers are young and inexperienced. He must also know the literature on the teaching method of each subject, so that he can place the most suitable books within the reach of his assistants; and he must be able to judge the quality of textbooks in almost every subject. It is immaterial which aspect of school work the headmaster chooses to concentrate upon in his own teaching—whether the humane studies, the arts, or the scientific and practical work; country people are of every type, and for the revivification of country life all these elements are needed; perhaps the most important activities are those which involve social training, whether they are music and dramatization or communal projects such as the making and tending of the school garden.

In many cases the headmaster will find his staff least qualified in artistic and scientific matters, and it would be well if his interests included these. Perhaps also history is a subject in which qualification would be especially valuable in the head of a small senior school.

Every head teacher should have made a special study of some group of subjects for teaching. Pass degrees in arts or sciences are very valuable qualifications, possessed now by a good number of rural head teachers; a very few honours graduates are also doing the work. Of the two kinds of degrees, the Pass is perhaps the better qualification: the "specialist" Honours degree would need more supplementation by subsequent study. It is now common for degree students to give only one year to professional training, after the completion of the degree course of three years. Young graduate teachers, especially men, not infrequently underestimate the importance of their professional studies of psychology and method—a profound mistake for the rural teacher, with his varied pupils, sometimes so difficult to cater for. The single year's professional training given in a University Department of Education after the degree, terminating in an examination for a University Diploma in Education, or in the completion of the Board of Education's Teacher's Certificate, does not necessarily include such subjects as music, drawing, needlework, and gardening and is apt to need prompt supplementation by practical work.

The Board of Education certificate obtained after a two years' course in a training college is still the most usual formal, preliminary qualification for head teachers, as for others, and it is perhaps the most useful preliminary qualification, since the needs of the schools are in mind in the planning of the training college curriculum, and a wider range of subjects useful in school are usually studied than is the case in the university courses. English and physical training are compulsory subjects, and every student must take one " practical " subject such as drawing, handwork, and music. But, even in this course, it is not possible to make special provision for the training of the rural teacher without impoverishing his general training, though some training colleges have made successful experiments in giving rural school practice, and short courses in rural sociology. In short, " Much of the more special advanced or technical study necessary to complete the equipment of the teacher finds its proper place subsequent to the period of more general training ".

A young teacher aspiring to headship should have more than either of these preliminary qualifications: more will be looked for in appointments to the new senior schools. If he holds the Board's certificate, his best course is probably to take a " deferred " third-year course, after a year or two of teaching. Some such courses are already available. Information about them is obtainable from the Board of Education and from the training colleges: the Training College Association has recently prepared a complete list, though others are being organized which cannot appear in the first edition of the list. Such courses include at present art and handwork (these are offered at a large number of colleges), dramatic work, biology, economics and social science, geography, history, French, music, physical training, rural science, domestic science, rural home management, and other subjects. No courses as yet treat fully of the rural community, through rural history, economics, and local government. But some of the courses in process of organization will doubtless fill this most serious gap.

Some of the courses enumerated above are given in universities, some in training colleges, and some in horticultural and agricultural colleges.

Numerous useful short " refresher " courses for rural teachers are organized, and are a help to the experienced teacher. Information relating to these will usually be obtainable from the local education authority.

The first courses of this kind were organized in 1919; by 1930 they were available in English, geography, mathematics, music, art, history, natural history, and educational psychology. Applications to attend these courses have to be forwarded through the local education authority. The Welsh Department of the Board of Education provides short courses for rural teachers; one in needlecraft and cultural subjects at Coleg Harlech, and one in rural education at Oxford. Other short courses useful to rural teachers, but not earmarked for them, are also available.

Numerous other short courses of a useful nature, though few of specifically rural content, are organized by local authorities, universities, and university colleges. Details of these will be found in the Board's pamphlet (published annually), " Vacation Courses in England and Wales and Scotland ".

Rural teachers already frequently obtain technical qualifications in handwork and rural crafts by the examinations of the Royal Horticultural

Society, the National Poultry Diploma Examination Board, the Beekeepers' Association, and the City and Guilds and London Institute.

When new assistants are appointed, advertisements should ask for applicants qualified in those subjects in which the school is weak. The detailed contents of a young teacher's certificate should be conned, since the training colleges offer a good many alternative courses and also advanced and ordinary courses, and a student may or may not have studied in college the subjects needed by the school. Technical qualifications in the crafts are of course valuable, but courses in handwork followed in college are related to the needs of the schools and involve some training in methods of teaching and are so far preferable.

Uncertificated assistants are sometimes an important and valuable part of a rural staff, and must continue to be so, if the present small numbers in classes are retained. Usually the local education authority makes some provision for the training of such teachers in Saturday classes and, in a few cases, by sending advisory teachers to work with them. All such help should be welcomed, and such teachers encouraged to qualify themselves especially in some one or two subjects, as a good standard of work achieved in one department always has a tonic effect in others.

The qualifications most useful in the head or sole teacher of a junior school are different from those needed by the staff of a senior school. The possession of a profound interest in individual children and, by consequence, in teaching method, is more necessary than that of great proficiency in any one subject. Such a teacher must have a gallant preparedness to learn many things for the sake of helping her children in them, for it is impossible for any training college course to give all the kinds of skill needed by a good junior teacher, or by one solely responsible for a school. She should, however, be qualified in as many as possible of such subjects as drawing, handwork (including elementary needlework), gardening, and music. Some special qualifications of great value would be a good knowledge of music, and love for outdoor games and physical exercises. A love for outdoor life, and a knowledge of and love for nature and the fields, are essential since it is in the earliest years of school life that love for the countryside should be cultivated.

General Position and Duties of Head Teacher of a Senior School

Something must be said of the general position and duties of the head teacher of a senior rural school, as the reorganization of schools raises some interesting problems, as for example the relation of the central school to the tributary schools and the dependence of the success of the central school upon some non-educational factors.

It has been the case in the past that junior schools sending pupils to a common central school have been totally ignorant both of its methods and of each others', and the consequence has been that the children have spent the first year in the central school in adjusting themselves to new methods, and acquiring special parcels of knowledge or kinds of skill merely for the sake of that adjustment. Something could be done to prevent this, if the head teacher of the central school would arrange meetings between his own staff and those of the junior schools. Some measure of agreement could probably be reached as to the standard to be attained in the three R's by the end of the children's junior school course; successful social meetings would probably lead to an exchange of views which in its turn might bring about the approximation of other courses. Co-operation must, of course, be voluntary, and can only be brought about by personal influence.

Another matter in which the head teacher is interested but has little power of direct action, is the provision of hygienic facilities for the children who come to him from a distance. Children suffering from discomfort after long walks in the wet, and eating sandwiches for dinner in cold weather, are unlikely to do the best work of which they are capable. No difficulty would be experienced in making arrangements for meals, the drying of clothes, or the conveyance of children in the case of large schools in new or newly-modified buildings, counting a domestic subjects mistress among the staff, but there is as yet no guarantee that satisfactory arrangements will be made in all of the small senior schools. Where young children stay at school for dinner, provision should be made for the filling of their leisure time in a profitable way. Books and quiet games should be available in the winter, and the children should be encouraged to take up games in which skill can be developed. They may also be given opportunities to pursue their hobbies during this time. If no provision is made the children behave in a rough and unmannerly way which is carried over into their life in the school session. As an important matter of detail it should be stated that, where no provision is made for school meals, a rule should always be made that scholars taking meals at school should eat them in the building; a room should be prepared for the purpose each day and the rule enforced. Exceptions may be made in the summer term under rules, but scholars should always be taught to take their meals in an orderly and quiet way.

CHAPTER V

Types of Rural Post-primary Schools

The most common type of post-primary will be the *non-selective senior school*, with or without a junior department attached. These will vary very much in size. In small towns, in centres of smallholders or market gardeners, in rural districts with an industrial element, they may be as large as typical urban schools. In country towns, even those completely surrounded by farming districts, very few boys or girls proceed into rural work; the boys and girls coming in from the country will not be in the majority. There will be a tendency in these cases to deny the importance of any type of rural work, and to approximate in type to urban schools.

In a measure this temptation will assail all the larger central schools in matters of methods of teaching, even where rural subjects are adopted into the curriculum. Classes will be fairly large, and the old and very profitable methods of the country school—known now as " individual " and " group " methods—with their very great contribution to training in character and individuality, will be lost to the children. This disappointing tendency has been clearly seen in America, where the policy of " centralization " has been pursued for many years, in spite of the fact that the theory of rural education is there much discussed and in some senses well understood. Where this loss in method occurs, it cannot be made up by mere subject-matter. The children in the unselective central senior school will have a wide range of intelligence. Owing to the lesser number of types of schools in the country (to the absence of the selective " senior " schools usually known as " central " schools), the school retains all the children except those who win scholarships to secondary schools; it will be common, at any rate at first, for it to contain children capable, under changed circumstances, of having won scholarships, for besides the difficulties of the tiny rural school from which some will have come, there is the fact that many rural families have no ambition for the present type of secondary education for their children, and that some cannot afford, even with maintenance allowances, to avail themselves of scholarships. Thus it will be the duty of such schools to provide courses which are both intellectually stimulating for the abler children, and which contain a large element of very concrete work for the less able.

Village survey-making has been the subject of a great deal of discussion, and of some experiment. Useful examples of surveys are to be found in *Village Survey-Making* (Board of Education Pamphlets, No. 61, H.M. Stationery Office, 1928), where methods are discussed to some extent and results are shown in text and maps.

Survey work, however, is a broad-based study, of value under all circumstances, perhaps especially for schools in country towns, as it is of interest equally to the residents and the incoming pupils, showing as it does the intimate relations of town and country. (Information on such work is obtainable from the Sociological Institute, Le Play House, Belgrave Road, London.) It is possible also to plan scientific courses which throw light upon both agriculture and other industries of the town and district: in a quarrying district a course in geology could take account of both.

All unselective central schools in town and country will depend for the continuation and enlargement of their influence upon out-of-school and post-school activities. All their pupils should receive continued education of some kind. Larger numbers of farmers', smallholders', and labourers' sons ought to proceed to farm schools. Others should find provision of various classes in centres, probably in the senior school buildings themselves, or in such " village colleges " as the one being tried in Cambridgeshire. Such a centre could well have a Young Farmers' Club associated with it, to which the oldest children in the school, and others up to twenty, could belong. The object of these clubs is to enable the young people to carry on some small agricultural or horticultural process—such as bee-keeping, calf-rearing, or gardening—at a profit, while learning to co-operate with one another, and something of how to keep accounts, of the advantage and methods of insurance, &c. Full information about their organization can be obtained from the Board of Agriculture.

In connexion with girls' work two questions are involved: " Should girls' work be differentiated from boys'?" and " Should girls' school studies prepare them for a country life?" The latter question has recently been considered at length by the Inter-departmental Committee of the Ministry of Agriculture and the Board of Education, and its findings published (" The Practical Education of Women for Rural Life ", H.M. Stationery Office, 1928). It has also been answered by implication in this essay. The futures of girls as of boys are too uncertain in particular cases, and too varied in the event, for any industrial bias to be practicable before fourteen. But when once a rural girl has elected to remain at home on farm or holding, her need for training is as acute as in the case of a boy. The pamphlet mentioned above gives the number of women with an " independent " interest in agriculture as 100,000, and those with a " co-operative " interest as 1,000,000. It is essential that the wives of smallholders and small farmers shall understand their husbands' business in all its broad lines, and shall have detailed knowledge of one or two of its branches. This is almost a condition of success, as garden and poultry, and the use of produce for home purposes, are in their hands. It would also be better if more labourers' wives undertook work of these kinds at home, instead of " charring " away from home.

CHAPTER VI

Infant Work

As was suggested above, the rural head teacher will often find himself ultimately responsible for an infant and a junior department, and the success of his school will in large measure depend upon these departments.

In the case of infants the first definite achievement he should look for is the establishment of good habits (remembering that this, carried out in such a way that they will be permanent, and not sloughed at the first possible moment, takes time): punctuality, regularity in visits to lavatory, and in washing, the prompt carrying out of routine, and of occasional exceptional commands, and all the habits of decent social intercourse. Among accomplishments less simple, he will expect of his infants' teacher that she live in a natural way with her children, and cause them to live naturally with each other. To this end he will find a way of turning rigid heavy desks into movable tables, thus destroying the class formation, which is death to the true life of an infant school. He will expect her to keep the children, during school hours, in contact with real things—toys, nature, garden, tools, and utensils—not only through the sense of sight, but by handling, smelling, weighing, in a word, *using* them. With contact with objects, there will also go hand in hand the growth of vocabulary. This will happen naturally to some extent, but the teacher should also deliberately note the additions to the children's vocabularies and feed them with new words at a reasonable rate. There should be no " conversation lessons " on the time-table; the children must express themselves in the course of work and play in relation to their purposes. With certain exceptions, all lessons should be conversation lessons. In view of the inarticulateness of many country children, not only those of labourers, but also in many cases of those from well-to-do homes, this is of the greatest importance.

Of the three R's, to take number first, it may be said without delay that too much is often asked. The process of " division ", with the exception of some practical exercises in sharing, may profitably be left till the children are seven. In the other processes the work should be practical, number being an abstraction from known, real objects. The children should become swift and sure in their manipulation of small numbers rather than struggle for comprehension of large numbers. Much of the work will naturally be individual because of the very varying degrees of speed, and interest in number, manifested by children at this as at other stages.

The teaching of reading is an extremely complicated and difficult matter, though this fact is obscured by the universality of the power of reading. Ideally speaking, children ought probably not to learn to read before the ages of six in some cases and seven in others, but the organization of a rural school often makes it essential that good progress in reading should be made in the infant school, for it is impossible for a teacher who has to teach the children of seven, eight, and nine together, to be responsible for the beginnings of reading with " Standard I ", because the demands of children of eight and nine make very great inroads upon a teacher's energy.

The extreme persistence required in the teaching of reading is not always understood by the young untrained teacher. This is perhaps the determining reason, in the country infant school, for the retention of script writing. This can be taught in connexion with the reading. Because of the similarity of " script " and " print " the learning of writing helps greatly with the learning of reading, and though there are more modern and more scientific methods of teaching writing so that a beautiful and swift cursive hand is produced in the end, the head teacher will do well to consider the organization of the infant school in great detail before pressing the teacher to abandon script, while if he has previously asked for the old " civil service " script, he should abandon it.

Handwork in the infant school will occur, like conversation, in very many lessons. The children should be accustomed to use material of many kinds, so that their experience is widened, and the hand is used in many ways, giving it strength and suppleness for the chosen forms of technique which will come later. Among manual activities suitable for infants, and possible in every school, may be mentioned paper-tearing and cutting, modelling with plasticine, clay, and sand, paper-folding, papier mâché, and raffia-weaving. The value of these depends largely upon the degree of initiative encouraged in the children, e.g. paper-cutting is of little value if children merely cut round outlines provided by the teacher, and paper-folding is a much-abused occupation when the teacher dictates each step in the procedure, instead of encouraging the use of the children's memory and powers of observation and inference. Modelling in plastic substances is of especial value both in the training of the imagination and of the muscles of the hand, and does not easily lend itself to mistaken method. If children move and speak freely and learn to pursue their own purposes, they will not be greatly harmed by minor mistakes in method. A head teacher in a rural school, untrained in infant work, should school himself to recognize and to suspect such conventionalities and artificialities as the teaching of reading to large groups of children together, the breaking up of the time-table into set periods of twenty minutes, the stereotyping of class formation, the isolation of any one subject from another, the hurrying of little children in the acquisition of formal knowledge or technique in the hope of saving time later.

CHAPTER VII

Junior Work

The Junior School

It is intended to devote a fairly large section of this article to the work of the rural junior school, because less knowledge and guidance is as yet generally available as to the education of the child of " junior " stage than as to that of the infant or the adolescent, and because it is of vital importance both in itself and as a part of the foundation for future work. The aims of the junior classes incorporate those of the infant school, but enlarge and modify them in various ways. The children are, however, in a stage of development very different from that of the infant—their mood and their powers have greatly changed, and methods in the junior school have to recognize the great physical vigour, the self-assertiveness, the practical bent, and the moral bluntness of the nine- and ten-year-old.

Among the aims of the junior school, we shall still have the close contact with real objects advocated for the infant school, but the " use " made of objects and materials will not now be typically playful; as often as possible a practical job will be done, or a useful article made. Also, the children must now make use of their knowledge of things seen at home to construct notions for themselves of life in distant parts and under strange conditions. Frequent opportunities for free movement and free expression, especially oral expression, must still be forthcoming, but there will be also the expectation of more frequent silent, concentrated work, and rapid strides in the technique of written expression will be made. In handwork, opportunities of working at models or drawings, whose subjects are to a large extent of the pupils' own choice, must be supplemented by technical instruction, given either incidentally, as is possible in clay modelling, or in a specially planned course, which may be necessary in cardboard modelling. The teaching of drawing illustrates in an interesting way the difference between the infant and the pre-adolescent child, and the consequent difference in his training. Little children are mainly occupied in drawing single objects, which they sometimes do over and over, or in the representation of scenes or actions, often from stories. They are unable to copy from an object; what they do is to attempt to define for themselves their own hazy images of events and things. But the child of eight is interested in the representation of objects and persons, and welcomes technical help in doing this, and is also ready to apply his drawing to practical uses in design and decorations, or as plans for use in various constructions.

Reading.—To take the three R's first: All the technical difficulties of reading should be over by the age of " 10 plus ", with all except the technically " dull and backward ". This result is not difficult if the highest infant class and Standards I and II are provided with series of finely-graded books, of which as a rule only one copy should be bought, or for purposes of group reading only six or seven. Thus a good supply of reading matter of a right degree of difficulty is provided. If the practice of the whole class reading together is abandoned, the amount of reading a child can do may be multiplied a vast number of times. The reading-matter for all junior classes should be varied; there should be, besides the usual fiction, historical narrative and geography, some books on natural history, and some on machines.

Written composition has been greatly overrated, and is of vastly less importance than good powers of oral expression. Still, its technicalities must be learnt at this stage. Interesting original lessons in this subject can only be given by a teacher with a real interest in language. There are, however, several helps, in even the most difficult circumstances: first, good oral expression is the best fundamental preparation; plentiful reading does more to teach the use of complex sentences, the finer kinds of punctuation, idioms, the use of figures of speech, &c., than any amount of class lessons; and finally it is the writer's experience that the children always enjoy working silently and individually through books of English exercises, of which several good ones are now on the market. We may add a parenthesis that it is essential in a rural school, where one teacher is in charge of children of several grades of achievement and intelligence, to teach the children to work individually from books and other apparatus. It is essential, therefore, for the head teacher to have a good knowledge of publishers' productions, from this as well as other view-points.

Arithmetic.—The method of teaching arithmetic in rural schools is usually to a great extent " individual ". Experience prompts teachers so forcibly to allow pupils to work at their own very varying rates, that few attempt much class teaching. Here again the choice of textbook is of very great importance. The question arises here whether it is essential that specifically " rural " arithmetic shall be taught. The rural environment does of course afford the opportunity for specially interesting arithmetical work, notably in mensuration, marketing problems, and profit and loss, and the competent teacher will find opportunities to give work relating to local farms, ruling prices, and farming operations. But the examples should be genuinely practical; this is only done when the use of local subjects involves genuine local problems in which the child is interested. In the junior classes it will be sufficient in the main to keep the arithmetic practical in a general way, to concentrate upon number, upon the development in the children of an appreciation of number value; examples will be as much from kitchen and garden and workshop as from the farm. It will be desirable, where children work a good deal alone, to use the different sections of a single textbook: this should be chosen for its mathematical soundness, and the clarity of its demonstrations; most of the " rural arithmetics " which have been published have been in these respects poor, and are to be avoided.

It has been said that the work will be largely " individual " in method, but group work for rapid mental calculation should be taken frequently for short periods; even here the class will need to be divided; one group may perhaps be taken before its individual written work, and another group at the end of the period. Similar groups will be formed for working at new types of problems. Working alone from books is apt to reduce the amount of time spent in " practical " work such as measurement.

We have assumed that all educationists will agree that the junior school should shoulder the major responsibility for the teaching of the three R's. There is somewhat less general agreement upon the other aims. Practice in modern schools is undergoing rapid change with regard to the teaching of history, geography, and nature study. Handwork is coming into its own, but in many schools is as yet very far from it. It has been said that the subjects are very little differentiated in the infant school, and the same in less measure should be true of the junior school.

The right time to systematize knowledge in the children's minds is during their senior school course. The work of the junior school is to give the children numerous experiences and a great deal of general knowledge which can be classified later. One of the Board of Education's pamphlets speaks of " creating a love for lore ". This is not necessary in the case of the majority of pupils; but it is necessary to refrain from ignoring and overlaying knowledge already gained, and above all, from reducing the children's zest for investigation. The writer has many experiences of boys frankly regarded as stupid in school, who have been encyclopædias of lore outside its walls.

The complaints that children are ignorant of the countryside come largely from people who only know the older children and youths who, having lost their zest, forget their facts; or from those whose experience is limited to children of the most depressed villages. Perhaps the most important functions of the teacher as regards rural lore are those of assisting the scholars to organize it and to check it. While lore needs to be recorded in the first instance, teachers will find that their records of statements of scholars or villagers are apparently or actually conflicting or contradictory in character. When lore of different kinds is being collected from several sources at different times, this fact may not be noticed, and it is therefore essential that the records should be organized. As soon as this is done the need of checking statements and of making further inquiries may be evident. The analysis and organization, and the checking of records are perhaps the most educational of the aspects of the collection and use of local lore. Even when no final statement is possible on subjects on which more than one statement is originally obtained, it is essential that each scholar concerned should realize the conflict of evidence and learn to suspend judgment, to pursue further inquiries or to get a clear view of reasons for conflict. Without some organization and some checking, the collection of rural lore is better left alone. Further, the analysis or organization of the lore makes the work truly co-operative for the school or class. Collection is always individual, often inclined to be competitive, and not all children have equal chances in making a collection.

School does not need to teach rural lore in the same sense as it needs to teach geometry or political history. It rather needs to recognize it, record it, give the children a sense that it is important not only for its present value to them but because of future values they will discover in it, and to help the children to link their own gains to the knowledge to which the school more actively helps them. A small piece of work which illustrates these facts was the collection of the field names of two small Oxfordshire parishes, whose children all attended one school. A teacher was presented with the twenty-five-inch ordnance survey maps covering the area. These were taken to school, and the project of collecting field names mooted. The maps were laid out on a large table, and very soon, though many of them had done very little map work of any kind, the children were identifying each house and spinney and rise in the ground. This was, to begin with, a revelation as to the wasteful laboriousness of many map-reading lessons. It took some three weeks to collect all the field names, the children tramping miles to see the fields, to interview farmers and labourers, holding long disputes with each other as to which of two or three was the " right " name of a field. Girls found as many names as boys. The lie of the land, so much obscured by field boundaries, became clear partly through the children's roamings, and partly through the names themselves, since some of the names—such as, for example, First, Second, and Third Barnacombe (the fields so named being the slopes of a small valley or combe)—are taken from the land formation. This was not obvious to the children without a little directed word-study, as the old words " combe ", " hanging " (for slope), &c., are not now used in the district. This word-study was very stimulating to the children of more intellectual capacity, for they learnt that the meaning of some words is past discovery, they are so old. A few were Celtic words, and it was possible to feel that ancient Britons lived in that village as well as on the seashore where Cæsar landed. Again other names date back to manorial organization, and though the children were too young to study this, they gained a familiarity with some of the facts about it which will make their knowledge more vital when it comes. Finally, perhaps the best gain, a large section of the names, historically the least interesting because only bestowed about a hundred years ago, caused the children to make a really great effort to imagine the appearance of the parish previous to the enclosures—without its hedges, with the hilltops, now fertile, covered with bracken and gorse, but also the fields and wells, now private, as communal.

This particular project of the collection of names has been undertaken on a large scale in Welsh schools, where the necessary maps were provided free of cost. Some English county might well try to get a complete record of local names.

As to the time required for such a project, probably it would last in all over three months, requiring perhaps at first some two hours per week of lesson time for study of the maps, for entry of names on the maps and the making of neat lists of the names for the children to retain, for word-study, and for correlation with history stories or lessons. At the beginning a little time must be given to it each day till they have settled down to coping with its difficulties.

Some schools, starting with some such collection as the one discussed, have been drawn on to the collection or study of other things, e.g. crops; local industries, present and past; old tools and kitchen utensils (the last being especially suitable for junior children). Where the junior classes are part of the same school as the eleven-plus children, extensive schemes of this nature have been carried out, in which water supply, communications, geology contours, distribution of houses, material and date of houses, farm boundaries, parish boundaries, occupations, &c., are studied. A few schools have made and even published surveys of their village.

Nature study in the village junior school is of necessity also largely a matter of local study. Here the children's collecting instinct has always been used, but the range of the collections made has been narrow, and the collecting impulse too little linked with the more general impulse of curiosity. The collection, naming, and study of wild flowers, often somewhat isolated from their habitat and from their relation to animal life, farming, &c., has been the staple " nature " study. But vegetable life is less thrilling to boys, if not to girls, than animal life, and the study of birds and animals should sometimes be substituted. Other subjects which have been tried with success are insect life, pond life, field study (pupils choose fields for special study for a year or six months), wild fruits and nuts, vegetables, stars, hedgerows. Here and there series of subjects each of which requires only short study have opened the children's eyes to the interest of neighbouring " common " things, e.g. gates, their fastenings and posts; methods of draining farm fields and buildings; certain particular implements or machines, e.g. the plough, harrow, the roll; the mechanics of certain operations.

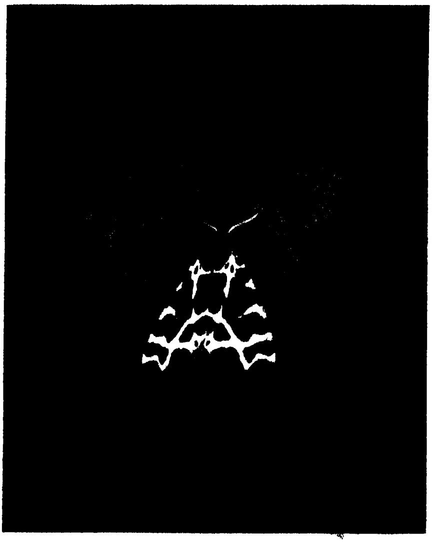
Much of the work must be done out of school and out of school hours; but as has been suggested, much is already done in this way. The boys visit birds' nests and study their flight in the evenings. School provides time and paper for the writing of records, and space for storing these; provides books of reference; and the example and emulation and admiration that are so important to the young self-assertive child.

One might turn aside for a moment to state explicitly that the " hobby " method can be applied with great effect in most of the work which involves, not technique in an abstract form, but the enrichment of life with experience and facts.

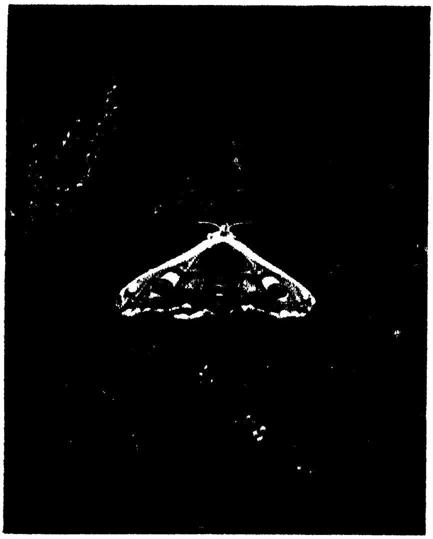
Some of the subjects mentioned above raise the question of the desirability of rambles and excursions in school hours. No doubt these will occasionally seem good; but they should be rare. The writer's experience is that they are not as a rule necessary; the children investigate the matter in hand with more thoroughness as well as more originality when alone. School time is consumed, not only in examination of the object of the visit, but in coming and going; they are tiresome to organize—inspectors and other officers have to be notified; if the children go in their own time, they go in groups of the right size, and of selected personnel, and while a whole class is too large a group for an excursion, to leave part of it behind is often to leave too heavy a responsibility upon a fellow-teacher. While these suggestions are not in accord with some contemporary opinions, they deserve the most careful attention and even trial. There is a tendency to depreciate the country child's knowledge and appreciation of natural objects and his local environment.

OIL BEETLE

BLUEBOTTLE ON MEAT



TIGER MOTH



EMPEROR MOTH

Geography and History in the Junior School

Geography and history at early stages will both be concerned with what may be called the concrete bases of the subjects. Early courses should supply the children with experiences and mental images of the matters about which, later, generalizations will be made. Some systematic courses of study will be suggested, but these must not be allowed to thrust out altogether work which arises out of the children's interests. Where homes lack space and materials, some of the work should sometimes take the form of hobbies; sometimes the systematic courses may be suspended in favour of work of a more general kind. Time is not lost in the case of rural children of poor background which is spent in making and arranging pictures relating to various countries, pictures of animals and birds, mountains, lakes, ships, ancient and modern, of all kinds of vehicles for land transport. Images of all these things are the raw material of scientific geography. The headings of the children's classification may be of their own choosing, but they should be encouraged to persist in orderly arrangement, and helped to reclassify their pictures or objects when their first arrangement proves unsatisfactory.

Pictures should not be regarded as providing all the illustrations necessary for either history or geography; for children of seven and eight, there should be three-dimensional models which they have themselves made or helped to make. The modelling should require genuine initiative. (The cutting out and colouring of hectographed outlines of objects and the setting up of ready-made cardboard models are of little value; the activity involved is of too shallow a nature to impress greatly the children's memories and the results have too little resemblance to real things to give truth to their conceptions.)

Geography (*Standards I and II*).—Work should include such practical study of physical geography as the neighbourhood permits—and every village contains hills and valleys, for the study of drainage; streams with islands and promontories, in the act of carrying down soil, and building miniature alluvial plains. The local market should be studied; if each class has an annual excursion, that of Standard II might take the form of a long half-day in the nearest market town. This part of the course would most naturally occupy the summer term. (Observations of weather —direction of wind, amount of rainfall, clouds, position and journey of sun, &c.—will need to be made during these two years. They should be associated with both the nature and geography courses.)

The complete study and teaching of the local geography of a district may involve a greater knowledge of geology than a teacher may possess, and the importance of this possibility should always be recognized.

There are always historical-geographical elements which may be used by teachers: the directions of roads and their routing over hill and valley, according to soils and contours; the placing of the villages according to soils, water supplies, contours, and roads; the formation or shape of villages on hill, plain, or valley; the " clustering " of villages in valleys, &c., and the natural divisions between clusters of villages; and the layout of farms or parishes; some or all of these will provide useful material in every locality.

Some time should be spent showing the relationship between the children's own district and the towns with which it has important connexions—the postal centre, the county town, the nearest large centre of population, and London. Of course, the human aspects of this study should not be lost sight of—there should be what we have called imaginative lessons on the lives of urban children.

In close association with the study of the district's more distant markets could come a course of work on means of transport, made very concrete, practical, and interesting by a little practical mechanics, the boys investigating machinery for themselves, and clarifying their knowledge in school with the teacher's help.

If the courses suggested above occupied five terms, the other could be spent in imaginative lessons upon life in various parts of the British Isles, where different industries and branches of agriculture are pursued, e.g. life in a coal-mining district, in the potteries, on a Pennine farm, on one of the northern islands, on a small Welsh mountain farm, &c. If time should not allow of this course the loss may be partly made up by seeing that the children's library of books for private reading includes plenty of geographical matter.

Map-reading should be begun at this stage; in the summer term the children should trace the brooks, &c., of their own village on the ordnance survey map, should make their own maps of the village for some practical purpose, make and use tracings of the survey map. Handwork or practical arithmetic lessons should include some plan-making to scale.

Little handwork has yet been suggested for the second year. One model to scale should be made if possible of some interesting local physical feature, preferably a valley. If this does not seem practicable, the children may construct a model of an imaginary island, after their study of local physical features.

In Standard III the children should make a detailed and systematic survey of the British Isles. A plea may be made for keeping the work as concrete as may be. Intelligent children of this age could be introduced to the agricultural atlas published by H.M. Stationery Office (Ordnance Survey).

Standard IV should cast their net widely both in geography and history —a combined course of the two subjects, comprising the history of early exploration and colonization, and the geographical study of the British Empire, approached historically. An explicit rural reference will not here be advisable; but the children's experience can be used in study of pioneering and colonization. This course will need to be preceded by some study of the earth as a whole; the globe should be constantly used throughout it and the parts of the British Empire shown in their place in climatic belts. Further reference to this course will be made later.

History.—The local and rural reference of history in the junior school will be, as is the case with geography, incidental and intermittent. The history scheme will be similar to that in other junior schools, but some village life has more resemblance to much of the life of long past times than modern urban life; methods can be more concrete, and the teacher may confidently start upon historical work at a somewhat earlier age than in the town. Almost every English village is rich in illustrations of the stages of civilization in this country, and some of these are capable of being understood in some of their aspects by young children—church, houses, cottages, field names, roads and bridges, mills, pounds, old tools and machinery. Since the history scheme will chiefly differ in its local reference from urban schemes, a course will be very briefly sketched, with expansions here and there to suggest the use of local material. It will be in the time given to handwork and other exercises in connexion with history that use will usually be made of local material.

Standards I and II if taught together might take two preparatory courses in alternate years: (A) A course of myths, legends, and heroic stories; (B) A course of studies in the life of primitive man. Course A does not lend itself to handwork: the children's reaction to the stories will probably be chiefly that of imaginative drawing, and more extensive handwork should be undertaken in connexion with geography or some other subjects; but the second course affords very fine opportunities for the children to become acquainted with some of the ancient uses of local material, and through this with its qualities. In a flint district the qualities of flints as tools can be experimented with. The dressing of skins is still often done in country homes, and this can be discussed if not actually done at school; toy coracles of willow can be made, miniature primitive looms can be made, wool can be washed, spun, dyed, and woven.

The children of Standard III will probably be familiar with some of the stories of English history through their general reading, and will be old enough to have some grasp of chronology. Their course will probably be a sketch of English history, presented more or less in story form, but chronologically. A pictorial time chart should be made by the children. The story of the Romans in England is one of great charm and should be told, whether there are Roman remains or not in the neighbourhood; should there be remains of a Roman villa, the children can draw plans of that particular villa, and reconstruct it in imagination by the aid of pictures; they may learn which of the village names are Celtic, and therefore pre-Roman, and ride their bicycles to the nearest Roman remains. But whether there are local connexions with Roman times or not, they can read Kipling's Roman stories and learn his verses, and try to feel an exile from Rome.

The next story will be that of Alfred—one so inwrought with legend that it is unsuitable for illustration of too literal or representative a nature; handwork will here be out of place. In the coming of the Normans, however, the class will have a subject which gives full scope to the interest in things and processes which is so strong in children of the age under discussion. Norman weapons and armour and Norman castles can all be modelled in great detail, if the school has a good selection of illustrated textbooks from which the children can learn details. If the class is divided into groups with each a different model to make, this story can be richly illustrated. If there should be a church with Norman features, or an Early English church, the children can model its various features.

Not all stories, it is clear, for this period will lend themselves to local reference; stories of the Wars of the Roses or of the development of the navy under Henry VII and VIII will probably be included in the course, and must pass without local illustration, though they may lend themselves well to practical and group work, as in the making of charts showing the evolution of naval ships. But again, stories of Elizabeth can be both locally and practically illustrated by visits to local houses with Elizabethan features, and by the modelling of Elizabethan furniture, tools, &c., of which examples are certain to exist in the neighbourhood. Of Charles I's time, the stories of Strafford and Cromwell may be chosen, and as almost every district took part in the Civil War, it is possible to discover, after some research, what were the reactions of local people of the time.

All rural children will appreciate some parts of Drinkwater's *Cromwell*, especially the lyric. The houses of this period are also of great interest, since they were the beginnings of the modern houses, many of them being still convenient and adequate dwellings. Numbers of farmhouses date from this time, and local examples can nearly always be found.

It is fortunate that the story of the 150 years after the death of Charles II, whose national politics are frequently not such as to interest children of ten, afford plenty of interest to rural children, since some very great and easily comprehended changes took place in agriculture during this period. New tools and simple machines were introduced; roots began to be grown; enclosure went on apace. Picture maps of the village in pre-enclosure days can be made, and the life of the small yeoman can be to some extent reconstructed, for his houses remain, and not infrequently there are other relics of his life. The Seven Years' War and the revolt of the American colonies will yield stories of wide general interest, which may be supplemented by the more intimate stories of two men of rural origin, the explorer Cook and William Cobbett.

The nineteenth century was crowded with events, knowledge of which would bring pleasure and profit to Standard III. The developments in the machinery used in common life give scope for historical teaching, linked closely with simple practical mechanics. Children would easily master the principles on which the new ships, road vehicles, and farm machinery were being built. They are also ready for some understanding of the transition from the small-scale production by hand to large scale production by machine. They could hear or read the stories of some of the inventors of machines used in textile industries, and their handwork, perhaps for a whole term, could be concerned with spinning, loom-making, and weaving.

It has been suggested that Standard IV should do a combined course of history and geography on exploration and discovery, such a course being a useful background for future senior teaching on world food supply and world agriculture.

The course will consist largely in the study of the voyages of the discoverers, explorers, and the settlement of early colonies. Study should not of course be exclusively directed to British navigators and colonists, nor should the study of climatic and other geographical conditions of voyages and colonies be studied without reference to the climatic belts of the globe. But all villages have personal connexions with the colonies, and the course can lead up to all our connexions with the more distant parts of the world, whether imperial or not; so that the climatic and other geographical conditions of the journeys which affected the growth of our Empire and general overseas traffic may well be studied in especial detail.

The use of maps will be an important part of the course.

CHAPTER VIII

Senior Work

History

Method in the senior school is different from that in the junior, in encouraging children to approach knowledge more directly. History may be studied by " topic " or by taking contemporary or recent conditions, and working backwards. In the hands of a skilful teacher, proceeding backwards may be more easy and profitable than the ordinary method of teaching history of " starting with beginnings ", and this may be done by dealing with a general set of conditions or by taking a set of topics separately; but whichever of these ways is chosen, the course should be arranged to provide a view of a general set of conditions. A course for senior classes may be arranged on these lines: transport and communications; food supplies and their sources; agriculture and its methods; clothing and its manufacture; the village and its government; the country and its government.

The transport section of the course, for instance, might have lessons sufficient to cover means and conditions of transport, (*a*) contemporary, (*b*) *circa* 1850, (*c*) *circa* 1790, (*d*) *circa* 1500–1600, (*e*) early and primitive conditions.

Modern means of transport and communications.

Transport.—(i) *Roads and Road Vehicles.* Motor-car and motorlorry: motor-cycle: internal-combustion engine: the cycle: decline of the horse.

(ii) *Railways.* Steam and electric: the main lines and the " feeders ".

(iii) *Shipping.* Steamers and their fuel: coal and oil: sailing vessels.

(iv) *Aircraft.* Aeroplane and the airship.

Communications.—Communications all based at one time on transport, now only some, e.g. postal services, merchandise traffic; now separated, e.g. telegraphy, cable " wireless ".

The procedure would then be that of comparing means and conditions of transport and communications at other periods. But it is not intended that only the static conditions shall be dealt with, and time-charts will be fully used for the display of dates and for the indication of evolutionary processes by date, as e.g. in the case of the telegraph and wireless, and the cycle, motor-cycle, and motor-car. Such a course as this has the advantage that any good encyclopædia will afford very much of the necessary material. In such a course the development of transport may, of course, equally be traced from its beginnings; but it is suggested that the method indicated will leave with scholars more practical knowledge and a better appreciation of contemporary conditions and their rise than courses which generally, though not of necessity, tend to emphasize the earlier conditions and developments.

The case of food supplies will afford a simple example of the method of moving backwards:

1930	1850	1760
Grain		
Four-fifths wheat imported; sources; organization of trade and transport; security of supplies.	Chiefly home-grown; developing trade; sailing vessels; poor land transport; fluctuations in prices.	England still exporting; Continental trade; risk of famine.
Meat		
Half imported; Empire sources, kinds; foreign, European sources, kinds; foreign, non-European sources, kinds; importance of refrigeration; development of refrigeration.	Nearly all home produced; imports mainly of live animals; imports from Europe; preservation by canning, &c.	All home-produced; poor quality; seasonal supplies, and autumn slaughter; home curing; importance of fresh meat.
Dairy produce		
Great importance of fresh milk; varieties; butter, cheese, dried and condensed milk; imports of manufactured products, sources; transport and refrigeration.	Home produced, except cheese; preservation of butter on farms; difficulties of transport; relatively greater importance of manufactured produce.	Home produced for home consumption; localized trade; relative importance of cheese; transport by road; producing areas.

The presentation of a complete series of suggestions for the agricultural section would require too much space to be attempted, and the following must not be regarded as complete or in any sense exclusive of other items:

	1930	1870	1760
General	Comparative importance of live stock; growing importance of production of vegetables, fruit, dairy, and poultry produce; decline of corn-growing; specialization in various districts; production for market.	Comparative importance of grain; simpler rotations or systems; market protected by poor transport; a commercial system of farming.	Domestic agriculture, production for consumption; sale of surpluses; production for domestic or local manufacture, wool, flax, &c.; simple rotations with some special crops.
Cultivations, &c.	Power; horse and mechanical; internal-combustion engine; tractive and stationary; implements, efficient and light of draught, and for all tasks; principles of cultivation now known.	Horse power and some steam-engines; implements improving (illustrate); development of drainage; large quantities of manual labour; drilling, and hoeing and weeding	Clumsy and inefficient implements (illustrate); ox and horse labour; primitive and poor drainage; common field cultivation; study of principles of cultivation; progress of rotations; broadcast sowing; manual work.
Harvesting	Machines, mowers, self-binders, loaders, &c.; horse and mechanical power; directive and manipulative manual work.	Development of some machines, horse-rake, &c., but still mainly manual; steam threshing; seeking machinery, and progress of invention.	Harvesting by hand, sickle, scythe, cradle; assistance of village and town labour required for heavy task; attempts at invention; threshing by flail.
Livestock	Types of stock; development of dairying; requirement of quality in meat; use of purchased feeding stuffs.	Types of stock; recognition and development of pedigree; stock for meat and wool production; dairying not important; use of some imported feeding stuffs; live stock and arable land.	Hard conditions of life and poor quality; local types of stock; selection of local types for improvement; improvers and progress of improvement; condition of stock and arable cultivation.
Agricultural commerce FERTILIZERS	Fertilizers used; manufacturing by-products, home and foreign sources; natural products, sources mainly foreign; kinds and sources.	Use of bones; manufacture of phosphates; discovery and transport of natural fertilizers.	Self-supporting agriculture; lack of knowledge of fertilization.
FEEDING STUFFS	Great variety used; sources, Empire and foreign; effect on methods of feeding.	Grain mostly used; beginning of commerce in some imports, linseed, cotton seed, locust bean.	Fattening a natural process, mostly in fields and woods; use of hay and grain.

In any teaching of the economic history of agriculture it is most important that this period should be covered, for it will be found that teaching for earlier periods tends to become more generalized teaching of social history in which the agricultural data is reduced to a minimum. On the other hand it is not intended that lessons should be given on these outlines except in connexion with the general course.

A teacher who can get access only to a very limited supply of general textbooks and sources will always find it more convenient to deal with " periods " and a range of topics within these, but one who can get access to a library or to a few good books, can by selection easily build up a course with sections as indicated and frame complete, useful, and interesting individual lessons. The teacher who uses this method will, of course, occasionally draw together the analytical threads and make " pictures " even for the most advanced and interested class.

If the " topic " method is used in the evolutionary way, it will be found that great interest will be aroused and a lot of information can be conveyed. This method should never be used, however, without planning a course of related topics or without planning for final lessons or revision, which draw the topics together. Lists of topics can be selected from the suggestions above, but here are two outlines:

HARVESTING PROCESSES

A. *Primitive.*—The discovery of grain; gathering by hand; storing in pottery; crushing or grinding by hand; roasting and cooking grain.

B. *Ancient and Mediæval.*—Making the sickle; making the scythe; the development of the " cradle "; the hook and stick; the threshing floor; animals treading out grain; winnowing by force of wind; the discovery of mill-stones and harnessing of wind and water; the making of sieves and the sifting of grain.

C. *Modern.*—The invention of the threshing machine; use of equine power, of water power, of the steam and of the internal-combustion engine for threshing; the invention of the winnowing machine; early attempts to make reaping machines; the invention of the mowing machine; development of (*a*) reaper, (*b*) self-binder from the mower; the " combine " harvester; disappearance of manual tools; the invention of the roller mill and the flour purifier; steam and other power in milling.

FARM DRAINAGE

Use of slopes, layout of fields and " furlongs " for natural drainage; ploughing for drainage; neglect of land not drainable by simple arrangements; drainage by pebbles or stones; drainage by brushwood; drainage of flat land by making canals; the evolution of the " turf " drain; surface and underground (spring) drainage; the stone culvert; evolution of pipe drainage.

Geography

A geography course for senior classes may effectually be planned, either by " commodity " studies or by " regional " studies, but as most textbooks or sources have been planned on a regional basis the regional method will almost certainly be the easier one to adopt. With a plentiful supply of large-scale wall maps such as are now available, it will not be difficult to plan a course of geography which will be equally useful to scholars who are to take up an agricultural or rural occupation and those who will obtain their livelihood in urban environments. In this connexion, every teacher in rural schools should recognize that British agriculture is no longer a " natural " or a self-supporting industry. In general it is rapidly becoming a semi-manufacturing industry, and in some of its phases it is already of that character. The British farmer not only competes with other farmers in the British markets for foodstuffs and raw materials, but he competes with them for the raw materials of which his products are largely manufactured. Tropical and sub-tropical countries supply the raw materials of which milk produced in England is partly made, and potash from the Continent, phosphates from Africa, nitrate of soda from South America, slag from British or foreign steel-works, and sulphate of ammonia from gas-works, now largely make the pastures which seem so native and so natural. Hence there are two aspects of a very practical interest in geography to be developed in rural senior schools.

The rural population is not only interested in agriculture but in forestry and in mining and quarrying, to say nothing of many other industries which are now being developed in rural areas. Some special local interests may be considered and catered for in the teaching of geography in rural schools.

Visual demonstration is an essential in teaching geography, and wall maps are absolutely necessary for the most effective teaching. Some of those in current use, however, are too much simplified to be at all accurate, and they need to be supplemented by closer study either of certain regions or of " commodity areas ". Some of the maps showing pastoral or prairie regions, forest regions, metalliferous regions, &c., cannot be improved upon *as a first approach*, and should always be used when obtainable, but they should always be checked by a closer study of contours and of industrial products of regions.

The essentials in the teaching of geography for agricultural purposes are climatology and transport. Geology and soils would be equally important with climatology if the necessary data were generally available. Rainfall, summer and winter temperature, length of growing season, type of inhabitants, facilities for transport, are obvious factors in the development of areas for the supply of food or raw materials for the commercial and competitive markets. Geographical principles need interpreting and some geographical dogmas need using with care. Factors of intelligence or of science, of mechanical invention in production or transport, of economic and social organization or even of government, often lead to changes in industrial and commercial use of natural resources which have been unexpected by geographers. Natural conditions do not alone determine the uses which will be made of the resources of any area, and uses radically change while natural conditions remain stable.

The interpretation of such changes and their causes may appear to be a part of history, but it will be no less a part of geography which is competently studied and taught. The extension of the wheat crop into areas of low rainfall has been partly due to applied science—the discovery of suitable methods of cultivation and conservation of moisture, and the discovery or development of suitable varieties of wheat for such areas; partly a matter of mechanical invention—the improvement of machinery and reduction in its cost of working for handling low-yield crops; and partly a matter of economic changes in other areas. The development of the trans-equator meat trade with Australia, New Zealand, and Argentina has been largely a matter of mechanical invention—the development of refrigerating machinery; and this also applies to some part of the production and trade in fruits. The factors of economic or commercial organization and of transport and storage are becoming of increasing importance in the geographical distribution of the agricultural industry.

The teacher of geography for agricultural or rural purposes will have no difficulty in proving not only its educational, but also its practical value if he will take the trouble to set down for (*a*) supplies of foods competing with British products, (*b*) supplies of raw materials for agriculture (and for general purposes), (*c*) supplies of industrial raw materials (often competing with products of British farms): (1) sources of supplies; (2) conditions of production, natural and economic; (3) conditions of transport; (4) changes in these sources and conditions, recent and possibly impending. He may then consider these in relation to British agriculture and rural population as a whole, or in relation to special interests; if time allows he should consider both, and proceed accordingly.

Proceeding on a commodity plan, he might, for instance, deal with wheat or wool.

Wheat.—Sources of present supplies; periods of year at which harvests occur; distance of different sources from Great Britain; distance of export areas from sea-board; climatology of export areas in exporting countries; any data on soils in these exporting areas; types of wheat grown; yields of wheat in export areas of exporting countries; yields of wheat in non-exporting areas; crops grown with wheat, or competing; types of population and of labour organization in exporting areas; methods of cultivation and harvesting; sizes of farms growing wheat, ownership, &c.; methods of storage, handling, and transport of grain; trade routes; recent changes in sources of imports of wheat; economic or political causes of changes in sources.

Wool (or Mutton and Wool).—Sources of supplies; period of year of marketing supplies; period of delivery of supplies to Great Britain; distance from Great Britain; trade routes; types of land on which produced; —hill, mountain, prairie, improved pasture; types of sheep kept; main product—mutton or wool; types or qualities of wool produced; chief uses of types of wool, and manufacturing areas; crops or livestock complementary to or competing with sheep; size of farms and of flock, ownership, &c.; types of population and labour organization; commercial organization for preparation for market, and marketing; methods of transport; tendency towards increase or decrease in supplies, and causes.

Such subjects as cotton or mineral oil equally lend themselves to this treatment if required.

Proceeding on a regional basis there will be description of contours and general features, of political divisions, of types of population and government, climatology, soils and mineralogy, chief products and markets for products, trade routes, &c. A certain amount of teaching on a regional basis is undoubtedly desirable.

In a development of the commodity plan two suggestions may be made: a study of the relation of dietary and general modes of life to geographical and economic conditions; and a study of types of population and geographical conditions in relation to economic and political development. If regional studies are pursued, particularly on the lines of industrial or commercial geography, care should be taken that Great Britain has been studied on these lines before studies of other regions are begun. Materials are now available for teaching the agricultural geography of England and Wales and to a less extent of Scotland, and they should form the foundation for similar studies of other regions.

Science

It is in the teaching of science and handwork that the less discerning advocates of " rural bias " will chiefly hope to see the bias shown. The suggestions following may seem at first glance to partake of the tendency to assume a rural destiny for the rural child, so that it may be necessary again to emphasize the fact that no course should be given in an elementary school which is not rich in general cultural value, alike, in the country, for boys destined to be engineers, personal servants, gardeners, and farm labourers, and for girls in equally varied careers.

There will doubtless be many attempts to develop the teaching of science in the senior and central schools of rural areas, but unless careful consideration is given to what is possible and necessary, there is likely to be a high proportion of failures. The countryman does not want to be " a hodman of science ", and will not become a manual worker in a laboratory, nor does the country boy need to be an adept in the use of test tubes or balances. The teacher who hopes to teach " agricultural science " to boys of eleven to fifteen years of age is practically doomed to disappointment before he starts. Experiments doubtless are useful, but many fail to work out according to forecast and some give extremely confusing results. The teacher has to remember that what passed for agricultural science twenty years ago is no longer current as such, and that the scope of applied sciences now used in agricultural instruction or practice is extremely wide.

In these days a teacher trained in the pure and applied (agricultural) sciences of botany, geology, and geography has an equal claim to be an agricultural scientist with one trained in chemistry and agricultural chemistry, or in botany and agricultural botany. Neither in any truth is an agricultural scientist but only a teacher of a section of agricultural science. It may be expected that in the near future schools will recognize as agricultural teachers those who have been trained in agricultural geography and agricultural economics, with one of the other sciences. But it is probable that the greatest need of the teacher in a rural school, particularly if a sole teacher responsible for courses intended to lead on to the practice of agriculture, is a sound and comprehensive course in biology along with courses in two others of the sciences mentioned. Biology is rapidly becoming an essential part of a child's general education: the time is probably not far off when biological training will be considered almost as necessary as language training.

The general aims of this course in a rural senior or secondary school will be those of developing powers of observation and powers of reasoning or inference within the sphere of interaction of natural forces. Knowledge which leads to power of control or use of natural forces in agriculture will of course be conveyed, but when the sole result is that of conveying bits of information which are now regarded as useful in the practice of agriculture, success is bound to be short-lived. Perhaps the most important aim of the teacher of agriculture or rural science in these schools is that of stimulating interest in his subject, of familiarizing scholars with the terms used in some of its branches, of creating facility in listening to or reading statements of scientific principles or inferences, so that the scholar may continue to gain knowledge by reading technical journals, or by attending lectures or classes, or by seeking advisory service (of agriculturists and scientists employed in local and national advisory service) in his after-school career. The boy or girl so stimulated and equipped is better taught than he or she who gathers a certain amount of information without discovering how such information is obtained or developing any active desire to go on acquiring it.

A course of teaching should be as comprehensive as may be possible. Useful courses might be built up on these foundations: the soil, its formation and qualities; water and the soil; the plant and its habitat; the plant and its food; the plant and its enemies; the animal and its habitat; the animal and its food; the animal and its enemies; plants and their uses; animal products and their uses.

The time spent on laboratory work should be very carefully considered, for the scholar does not need the powers of manipulation of the scientist's laboratory assistant. He may need a certain amount of demonstration; and he may need, as in agricultural botany, certain powers of identification, but in general he does need powers of observation and these may be developed out of doors as much as in the laboratory. While it is true that a boy may take more interest in the parts of a sample of soil that he has helped to separate than in those same parts when shown in a glass bottle, he does not need to go on with the physical and chemical analysis

DABCHICK'S NEST—EGGS HIDDEN

DABCHICK'S NEST—EGGS EXPOSED

of soils, for even as a farmer he would not make such analyses for business purposes. Scholars showing special aptitudes for experiments or for laboratory manipulations may be allowed to develop their skill; but in general, skill in manipulation will not be the object of laboratory work.

It is quite possible that the rural science course ought not to begin until scholars have had some teaching in agricultural history; and it is quite certain that good teaching in the history of agriculture and in agricultural geography is the best introduction to courses in rural science of the type required.

It will be realized that the general lines of a suggested course do not lead to a narrow interpretation of " agricultural science "; the course is educational and suited to scholars who may follow other careers. If in the last year of the senior school, or the last two years in the central school, there are groups of scholars intending to enter one or other of the branches of the agricultural industry, special provisions may then be made for them. Final courses would be built up on the foundations already suggested. There may be some specific instruction on the selection of plants for certain purposes, on cultivations and drainage, on manuring, and on breeds of animals and their purposes, on feeding, and on animal hygiene. But the teacher will study the needs of his scholars in relation to their interests and the examples and illustrations provided by the type of farming practised in the neighbourhood. In every case the teacher who would teach agriculture is advised to make a study of the best systems and practices of farming in the school area, not only of the contiguous parish, and especially to inquire for efforts towards improvement, experiments, and demonstrations that have succeeded or failed, for it is well known that trials of " improved " varieties of plants, practices in manuring or in cultivations in particular localities, do not always work out according to general expectations. It may also be said that farming business is not merely a set of processes in production, and that it includes marketing and to some extent the utilization of products.

Organization is also a factor in the success of the individual farm, and of any branch of the industry and those who follow it. The farmer must arrange his crops and the stocking of land not only to utilize the land itself, but to utilize all the labour staff at all the seasons of the year. He must arrange crops and stock to make the best use of power, equine or mechanical. He may produce excellent crops or stock, and yet fail to make adequate profits. Here are problems with which the " agricultural scientist " trained in chemistry and botany will not be familiar, yet problems recognized as of equal importance with those of manuring in crop production or feeding in animal husbandry. Data for teaching are available, and a teacher who has received some training in commercial subjects or in economics might very well develop study and teaching on these lines.

Moreover, as the agricultural industry is now organized, many scholars, even those proceeding to agricultural occupations, may never have control of crops, the selection of seed or of fertilizers, and may never have control of selection of animals and their foods, though they may have to milk, feed, or tend them. For those who must be farm employees a totally different training must be devised if their " occupational bias " in their education is to be well directed or effective. Schools and their directors have not even begun to think about this problem. But the training that farm workers need is in the physiology of manual work, the use of the limbs and muscles, conditions of economical and efficient use of energy, the causes of fatigue; and in the application of mechanical principles and forms of mechanical power to farm work. These are the things which chiefly determine their efficiency; they need also forms of technical knowledge related to crops and stock, but not the same forms as are required by the person in general control of farms and smallholdings.

Certain forms of recording and analysis of records may be associated with courses in rural sciences or agriculture. The charting of weather records where available, the making of plans of farms with the cropping of fields, drainage plans, or plans of buildings; the charting of records of milk yield, egg yield, or of live-weight increase may be practised whenever data can be obtained. But the principles of such work are quite as important as the " lessons " which on occasions the records, plans, or charts are supposed to convey. It is possible, and may sometimes be necessary, to make plans or charts which are themselves accurate without any understanding of the principles of accuracy or correct representation in such work, but whenever it is possible correct and incorrect methods should be shown and explanations of differences given.

Very little of actual production of crops or of attendance on livestock is really necessary for the teaching of rural science or even of agriculture in rural schools. The school garden is always useful, and the school may have bees, poultry, or other small livestock which under some circumstances may be quite useful. When stimulative work is required it is much better organized in connexion with the homes of scholars by such organizations as Young Farmers' Clubs. The teacher who has special capacities for teaching gardening, bee-keeping, poultry-keeping, should use them with whatever facilities are obtainable, but it should not be imagined that " agriculture " is taught thereby. On the whole, more effective and practical forms of observation will be developed if scholars are induced to bring materials required for study from gardens or farms connected with their " seven-day life " than with attempts to produce materials in the school garden. Where conditions rather than materials are required for purposes of teaching or demonstration, it will be better to take the group to the gardens or fields in the vicinity, and this can be arranged. In some cases it may only be necessary to direct attention to conditions which are to be seen and then to pursue questions on them at the appropriate time. While there are advantages in the possession of school garden or poultry yard, there are equal disadvantages when results of operations do not work out according to expectations or plans. Although there are outstandingly successful school gardens, it may be said that in general the most successful are the most ordinary and those which follow well-established practices, and this result may be expected in other branches of similar work. But the garden or poultry yard which does no more than other good gardens or yards in the neighbourhood is a little redundant in the really rural area. Special conditions may arise in semi-urban areas, but with these we are not immediately concerned.

Arithmetic and Mathematics

There has been much discussion of the need of special teaching of arithmetic for rural schools, and " rural arithmetics " have been compiled. We can only suggest, however, that if the general principle previously set out is followed, the procedure will be that of providing a thorough teaching of principle to whatever stage the study is carried, with continual reference to objects within the scholar's experience or to which his personal attention may be directed.

The important objects in teaching are those of laying sure foundations of principles, clear grasp of methods, and of showing application to everyday affairs. The subject of mensuration will occur to every teacher, and this may be taught in relation both to geometry and arithmetic. Calculations of manurial values of fertilizers, or of relative food values of feeding stuffs such as are now used, can be taught at the appropriate stages. It is perhaps important for practical farm purposes to instil an accurate sense of proportion, and a sure knowledge of methods of computing it.

In the higher stages of the central school some simple accounting might be done, and analysis of some forms of records might be pursued in exercises. For instance, in the case of egg-laying records, or for milk records:

FLOCK RECORDS.—Average annual yield per hen on original number in flock. Average annual yield per hen on numbers in flock at given date in each month. Average yield per hen-day.

INDIVIDUAL RECORDS.—Highest yield; lowest yield; median yield; average yield; to show variations from the average.

Differences in methods of computing averages, e.g. of " average " yields of fields varying in size having varying yields when the arithmetic mean and the true average is taken, may be illustrated.

Computations of time required for different tasks under different conditions will also be useful, e.g. a plough moving at 3½ miles an hour in (*a*) a square field, (*b*) an oblong field; or a mower moving at 4 miles per hour, (*a*) with 4½-foot cut, (*b*) with 6-foot cut. But whenever " problems " are set, care should be taken, at least in the first instance, that assumptions are consonant with actual conditions or with situations which frequently arise. Any one of the " rural arithmetics " will give many examples which may be used, but the teacher should always make sure that the method of computation shown is one based on sound principle.

The data may still be used although other methods of computation are sometimes employed.

Some plane and solid geometry will be taught, and should be taught to all scholars of sufficient capacity whatever avocations they may intend to take up.

If any simple accounting is taught in central schools, it should be taught with a view to the understanding of the relations between transaction and transaction, and between entry and entry, for the scholar should be sufficiently advanced in arithmetic to make accurate computations of the items and totals dealt with before he begins this study. There are better ways of pursuing arithmetical exercises than those provided by simple book-keeping.

Instruction for Girls

The suggestions outlined above, with the possible exception of the suggested agricultural development of the rural science course, may be considered equally suited to both boys and girls, for it may be assumed that most rural boys and girls have common experience up to eleven or twelve years of age. Differences in interests, of course, are evident before this age; and as these differences increase, differences in experience begin to arise. But the suggestions made as regards history, geography, and the foundation course in rural science may be adapted to the common experience of both boys and girls. Where both have to be taught together the history outlines (as at pp. 105–8) might be expanded by study of domestic arrangements, or by the study of dairy equipment and tasks in the dairy, at different periods. In the geography course on a commodity basis, treatment of the textile commodities, sugar, tea, &c., and reference to conditions of life in producing areas, would provide for some special interests. In the arithmetic courses some such adaptations may be made. Girls would be as interested as boys in data relating to poultry and small livestock, and in many parts of the country in data relating to dairy-farming and the dairy. Food values in human nutrition are at least as important and interesting as food values in animal nutrition.

" Domestic economy " will naturally be taught in many schools, and with many variations. Cookery is always appreciated; laundrywork is regarded in all sorts of ways from detestation to sufferance and pleasant appreciation, very largely according to equipment, conveniences, and methods of teaching. One economic and social need in the countryside is for higher and stronger demands of women for household equipment. Some schools have been criticized by villagers for teaching methods, &c., " beyond the means " or " above the heads " of the homes from which girls come, but to a certain extent this is desirable. In so far as teachers train for housekeeping it will not be that of the present, but that of ten, fifteen, twenty years hence. The teaching of the school should be in advance of normal housekeeping practices in the villages of the present day. The stress should not be on the " economy " in domestic economy, and it would be well in some respects if we could adopt the American term for the developed aspects of this subject, namely, home economics. The subject should be that of economics of the home in the same sense as we speak of the economics of the farm as " economy of the farm ", before the term economy gathered to itself moral and " saving " implications.

Practically all girls, whatever their subsequent occupation, require some training in domestic economy. The course in rural central schools should include domestic science as well as the actual manipulative work of cookery, laundrywork, &c. It should cover hygiene, a certain amount of physiology and bio-chemistry leading to nutrition, some of the science of laundrywork, household organization and management. In the line of pure science, chemistry or bacteriology would be useful, but in science teaching as such, there is no justification for limiting the possible subjects to botany.

A special plea should be made for drawing and designing for girls, both in connexion with housecraft and with needlework, and this might take the place of geometry or parts of the arithmetic course for boys. It would be desirable to continue the teaching of some æsthetic subjects to girls up to the final leaving stage, for they have need of æsthetic training. Boys, too, need to develop æsthetic standards and judgments, but as far as their work is concerned the fundamental forms of their products are determined by nature. Within the possible limits set by natural conditions they will develop qualities akin to the æsthetic in livestock or crops, and in the finished appearance of their tasks on land, fences, &c. How much of the formation and working for æsthetic ideals occurs on some farms is rarely appreciated by the non-farming public. Even more is probably needed: for the improvement of quality in farm products, now so much sought, is not only dependent on appreciation of qualities which are purely of a utility character, but also on appreciation of some æsthetic qualities. Shows, demonstrations, competitions, and market comparisons tend to develop judgments and appreciation in the sphere of men's work.

We have said that the future men and women of the countryside need education for leisure in addition to training for occupational purposes, and we would emphasize this need in the case of girls. A sound or attractive community life in rural areas will never be developed without the active and intelligent work of women in organizing social activities. Dancing, especially in the form of old English or folk dancing, is of great social value. Music in one form or other should be continued to the leaving stage.

Village girls of twelve or thirteen to eighteen or thereabouts often lack any facilities for play expression. They are too old for children's games, too young for many of the grown-ups' activities of a social kind; and they have nothing like cricket, or more commonly football, which meets the needs of boys at this stage. Whatever the senior or central school can do to fill this gap by developing team games such as hockey and netball will be worth doing. Here are opportunities for good work by teachers who are interested in games and in the general development of their scholars. There should be study of the possibilities of games for girls of twelve upwards in all senior and central schools.

Handwork

In the development of the curricula of senior and central schools, it is probable that many demands will be made for the teaching of " applied " handwork, and it is perhaps natural that they should arise. There is, however, very little that is educational in milking a cow or even sometimes in using farm tools. Parents and employers must and should still expect to teach young workers the rudiments of their manual tasks. The function of the school is to explain the principles underlying such of these tasks as need or deserve explanation, and to give general muscular training. Those who are responsible for the training of the future generation of agriculturists have also to keep in mind the changing character of farm work and of the implements and methods by which it is accomplished. If a distinction could be drawn it would here be drawn between manipulative training which is intended to develop general powers of observation and manipulation, and vocational training which is intended to develop special powers of manipulation and especially such powers as are required in agricultural pursuits at any given moment. Perhaps no clear-cut distinction of this kind can be drawn, for all observation must be of specific objects, and all powers of manipulation must be powers of manipulating specific materials. Yet there are differences in aims of methods of manual instruction which are important. One may be concerned only with the accomplishment of the immediate task in hand, another with the immediate task and the reasons why it is best accomplished in a certain way, or why certain materials or tools are used in preference to others. Emphasis should be laid on the latter type of method.

At the age of fourteen, even of thirteen, many boys will want to " do practical work ", and some may be impatient of too much instruction which does not effect the accomplishment of the immediate task: theirs not to reason why, theirs but to do—or try. This undoubtedly is the type immediately most sought by many employers, but it does not necessarily make the most efficient workmen in the long run. But a guiding fact for the teacher is that the general run of farmers or farm workers, even many rural craftsmen, are themselves poor teachers. The actual handwork, of whatever character, should be accompanied by as much as possible of explanation.

Woodwork will be the most common form of handwork for boys, with needlework, laundry, or cookery for girls in country schools, but it would be an advantage to many girls to receive some training in the manipulation of simple and common tools in connexion with their housecraft. Indeed, it might be said that every country girl should be able to handle a hammer, a screwdriver, and a spanner with efficiency. Where equipment and materials could be obtained, and a teacher is available, metal-work might well form an alternative to woodwork for boys in some rural central schools. A forge, a lathe, bench, and tools, with possibly an acetylene welding plant, would be equally valuable and useful as a carpenter's kit.

The nature of the work done will depend partly upon equipment and facilities, partly upon other activities of the school. Where there is a poultry yard or an apiary, some woodwork will be done in connexion with these enterprises, or in connexion with gardening. The instructor and his pupils may prefer to make articles for the household, models of farm requirements, or some full-scale objects which are used on farms. There is room for each type of product, but in each case there should be building up from the simple processes or forms to the more complex. Immediate utility of product should not be put before the teaching purpose, yet at the same time one object will be that of enabling each pupil or group of pupils to complete one or more objects of utility in the time available. The training should also cover the use of an adequate range of tools, and at times there may be reason for specific training in use of tools without the object of utility production.

Again we would urge that there is need of training for leisure as well as for occupational purposes, and would interpret utility in that sense. If a boy desires to make a simple piece of furniture, or a group of boys wishes to make a wireless cabinet, the desire is just as praiseworthy as that of making a beehive or a dog-kennel.

GARDENING

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GARDENING

CHAPTER I

Introduction

The school garden is becoming increasingly important as a focal point for other school subjects, adding interest and reality to the general training of the children.

The garden is as important for the urban as the rural schools, helping to bring about a better understanding between town and country, and a keen power of observation and interest in things alive. Incidentally, the school garden may also serve as a valuable object lesson to the neighbourhood, and has often played a large part in overcoming the bias frequently found in rural areas against modern methods of cultivation. The work in the garden also provides a means of obtaining the sympathy and interest of the backward child, and, quite apart from the manual work, much instruction can be conveyed in a more easily assimilated and concrete form.

The Teacher.—The educational value of the work done in connexion with gardening is usually far greater where a teacher on the staff of the school can give the instruction. If this is impossible the class-teacher should be in attendance when the lesson is being taken, to maintain discipline and to make possible the satisfactory linking of the subject with other school work. In this connexion, it has to be remembered that it is not necessarily the best kept garden, or the one that produces the finest produce, which is of the greatest educational value. The school garden is not attached to the school for vocational training; it is therefore preferable to have inferior gardening technique and a thorough correlation of the subject, rather than a fine garden and nothing more.

The teacher should attend courses of instruction in school gardening whenever this is possible, and make the fullest use of the county organizer, or county horticultural staff.

General Scheme.—The actual lines along which the work is developed is a matter for the teacher to decide, depending very largely on local conditions, but under all circumstances the work should as far as possible be that of the children and not the teacher, and, as opportunity occurs, alternative methods of planting, manuring, sowing, &c., should be adopted, and a careful record kept of all operations and results. In some counties facilities for the work are greatly improved by the provision of artificial manures and fruit-tree sprays for each school garden, the distribution of sets of fruit trees on standard Malling stocks, the opportunity to obtain cuttings of flowering shrubs, herbaceous plants, &c. Where all these things have to be obtained from the annual grant, or the sale of produce, the development of the garden is often a difficult matter and sets a limit to the scope of the teacher.

The Garden.—It is always an advantage to have the garden near the school, in fact much of the value of the garden is lost where this is not so. In urban districts this is often impossible and a gardening centre used by a number of schools is provided. There are obvious disadvantages in this system, and in a great measure the satisfactory co-ordination of the work depends on the teacher responsible for the gardening class at each school.

The garden should be in an open situation, which is well drained or where draining could easily be accomplished. Heavy clay soils are always difficult for children to deal with at the start, and also need better weather conditions to enable cultivation without fear of damage to the texture; where possible, therefore, light easily worked soils should be chosen.

The lay-out of the garden should provide for plots for the children, either " single ", " dual ", or " common ", according to circumstances and the ideas of the teacher. It is an advantage for the children who have been taking gardening for two or three years to have individual plots, that they may work out their own ideas, and see the results of their own work. Provision should also be made for a fruit plot, an experimental plot, a nursery bed for propagating young plants, cuttings, &c., and flowers.

Where there is plenty of ground and a suitable class, the garden may be laid out on more ambitious lines with some attempt at landscape gardening. In a small garden the best effect is always obtained by a very simple arrangement of beds and paths.

Tools and Equipment.—The tools provided should be of a suitable size and type for the district, and the children should be instructed in the art of using them.

The tool-shed should be large enough to accommodate the tools properly arranged on racks or hooks, and also store seeds and manures. Where the garden is some distance from the school it is an advantage to have a shed large enough to act as an auxiliary classroom in showery weather. All tools should be cleaned and rubbed with an oily rag after use.

Competitions.—Exhibits of produce from the school garden at local shows are not out of place, but competitions between different school gardens are frequently invidious and unfair, as the conditions of soil, the age and number of boys, distance of the garden from the school, &c., vary so much.

CHAPTER II

Courses of Instruction

It is assumed that most of the serious gardening will be confined to the older scholars of eleven years of age or over, although there is no reason why the younger children should not look after a small portion of the garden, such as a border of annuals or flower-beds.

In many cases it is impossible for children to be in the gardening class for more than one year, but the following suggestions are drawn up for a progressive three years' course. It is always best to arrange the lessons indoors to coincide with the seasonal operations outside. The course is bound to be modified where rural science or nature study have not already played a considerable part in the school curriculum, as some elementary knowledge of plant physiology, or " how plants live ", and the germination of seeds is essential to the proper understanding of most garden work.

1st Year—Autumn Term.

Lessons Indoors: Soils and Cultivations.—The origin of soils, weathering, different types of soil, soil fertility (depending on soil depth, tilth, water (drainage), air, lime, and plant food). Inhabitants of the soil, earthworms, bacteria.

Digging, double digging, hoeing, rolling, and their effect on the soil.

Work in the Garden.—Digging, double digging, draining, ridging (on heavy wet soils). Grow one crop, e.g. potatoes, across the double-dug and single-dug portions to show the effect on the crop.

1st Year—Spring Term.

Lessons Indoors: Vegetables.—Seeds and seed-sowing. Preparation of seed-lists. Varieties, the importance of " strain ". Times of sowing. Outline cultivation and sowing of brassicas and roots.

Work in the Garden.—Preparation of seed-beds, seed-sowing, hoeing. Hoe one half of a plot *across* the crops twice as often as the other half. Observe the result.

1st Year—Summer Term.

Lessons Indoors: Vegetables.—Outline the cultivation of potatoes, legumes, and other vegetables.

Work in the Garden.—Planting of brassicas, thinning of seedlings, sowing, hoeing. Leave some seedlings unthinned, some thinned to the usual distance, others to twice the distance.

2nd Year—Autumn Term.

Lessons Indoors: The Vegetative Propagation of Plants.—By cuttings (root and stem), layers, division, runners, suckers, bulbils, &c. Show that the success of many weeds depends on the ease with which they multiply by vegetative means.

Work in the Garden.—Digging, making cuttings, dividing herbaceous plants. Make cuttings of one-, two-, and three-year-old wood of apple, currants, gooseberries. Note the results. Make cuttings of roses, with and without a " heel ".

2ND YEAR—SPRING TERM.

Lessons Indoors: Manures and Manuring.—Revision of the soil. The soil as a storehouse of food. Plant requirements. Lime. Organic manures, artificial manures, and their uses. Water cultures.

Work in the Garden.—The making of a permanent eight-plot test. Weighing out different manures and applying at varying rates. Ordinary spring cultivations and seed-sowing.

2ND YEAR—SUMMER TERM.

Lessons Indoors or Demonstrations: Flowers.—Half-hardy and hardy annuals, biennials, herbaceous perennials, flowering shrubs, roses.

Work in the Garden.—Sowing hardy annuals, thinning, &c. Planting out half-hardy annuals. Staking and care of herbaceous plants. Pruning roses and flowering shrubs.

3RD YEAR—AUTUMN TERM.

Lessons Indoors: The Cultivation of Fruit.—Outline the cultivation of commoner hardy fruits, e.g. apple, pear, plum, red and black currants, raspberries, and strawberries.

Work in the Garden.—Planning and Planting Fruit. Winter pruning and spraying, digging. Leave some trees unpruned, prune some hard and some lightly. Plant trees of the same age and variety on different stocks under similar conditions.

3RD YEAR—SPRING TERM.

Lessons Indoors.—Grafting, Stocks for Fruit Trees. The grouping of pests and diseases for treatment. Endeavour to hatch eggs from sprayed and unsprayed trees in school. Collect chrysalids and hatch.

Work in the Garden.—Grafting, layering stocks, collection of eggs of pests and specimens of fungoid diseases. Seed-sowing.

3RD YEAR—SUMMER TERM.

Lessons Indoors: Budding.—Life histories of some of the commoner plant troubles. The insects should, if possible, be kept in breeding cages in school.

Work in the Garden: Budding.—Summer spraying of fruit. Summer pruning. Observation of pests on sprayed and unsprayed trees, &c. Note the dates of flowering of different apples.

Every opportunity should be taken of keeping records of the work and the growth of the plants, and these opportunities will be increased by adopting alternative methods, or never treating a plot all over alike. This method not only adds interest to the work, but is the only sure way of assessing the value of any operation or treatment. Teachers should bear in mind, however, that the scientific value of the results will not usually be very great, as unless the same experiment is repeated a large number of times, or over a long series of years, the small variations in soil and other conditions will upset the accuracy of the results. Nevertheless, as demonstrations and as a training in observation the trials are invaluable.

CHAPTER III

Suggestions for Lessons

The following suggestions for the treatment of the different subjects have been found useful. It is not possible to deal fully with all the subjects in the space available, therefore those subjects have been chosen for detailed treatment which have been found to present exceptional difficulty.

Vegetables

A variety of vegetables should be grown, the choice varying with the district.

Strain is probably more important than variety. This may be shown by obtaining seeds of the same variety and kind from a number of different sources and growing them side by side. In the course of a few years it will be possible to ascertain the most suitable varieties for the school garden.

The Seed-bed.—The condition of the soil is of greater importance than the actual date of sowing in the spring. This may be shown by sowing seeds in a poor tilth and under good conditions.

For the late summer sowings of cabbages, lettuces, and onions, the date is of considerable importance in order to obtain plants of the right size to stand the winter, or plants that are not so large that they " bolt " in the spring.

Seed.—Good seed should be bought or home-saved seeds of some plants may be used, e.g. peas and beans. The seed should be sown thinly, and where kinds of vegetables are sown that germinate slowly, e.g. onions or parsley, a quickly germinating seed such as radish or lettuce should be mixed with the seed. This enables the rows to be seen quickly and the ground kept hoed. Thin the seedlings as soon as they are crowded. This is best done in two operations and on dull days.

With the younger children it may be found an advantage to grow the late brassicas on a separate plot to facilitate digging on the other plots.

Fruit

The choice of varieties and kinds will depend on the local conditions. Generally with apples a heavy soil is most suitable for culinary varieties, and a light soil for dessert varieties. Other considerations when choosing varieties of apples, pears, or plums are whether the season of the variety is early or late, if it is prolific in cropping or otherwise, and the season of flowering.

" Strain " is again of exceptional importance, especially with such fruits as strawberries, raspberries, and black currants.

Pollination.—All fruit sets better when cross pollinated. The blossom of some varieties of apples, pears, and plums is self-sterile, i.e. it requires the pollen of some other variety for fertilization to take place. The flowering period of different varieties varies, especially with apples.

Type of Tree.—For apples, pears, and plums the smaller the type of tree, i.e. the smaller the framework of branches, the earlier the tree comes into bearing, e.g. a cordon as a dwarf type of tree, and a standard (a tree with a 6-ft. stem) as a large type of tree. For cultivated ground the smaller types are usually the most suitable. Stock and chickens may be run under standards in grass. The trees should be planted at approximately the following distances apart:

Single cordons	2 ft. (planted obliquely)
Horizontal espaliers	15 ft.
Bush (apples, pears, or plums) ..	12 ft.
Half standards	20 ft.
Standards	30–40 ft.
Currant bushes, &c.	6 ft.

Stocks.—The importance of a careful selection of the root stock on which a tree is growing to suit the variety, type of tree, and soil cannot be over-emphasized.

Apples, pears, plums, &c., are usually propagated by means of budding or grafting. This is frequently an easier and surer method than raising the trees from seed or cuttings, and in addition gives a very large measure of control over:

1. The vigour of the tree (amount and rate of growth).
2. The habit of growth (upright or spreading), fruiting (quality, size, and regularity of crops), and time of blooming (early or late).
3. The age at which the tree first produces blossoms and fruit.

The East Malling Research Station has examined existing stocks, raised new ones, and classified them into groups according to vigour. If a particular stock from one of these groups is selected and propagated by layering, the desired qualities, behaviour, and vigour will be retained with consistent uniformity. On the other hand seedling stocks (frequently raised from pips from the cider press in the case of apples) are variable in vigour, and the resulting trees display corresponding irregularity in cropping and growth.

Knowing the characteristics and behaviour of the Malling standard stocks, a grower can choose the type which will best suit a particular variety, form of tree, and soil, and can also regulate the time of bearing.

Apples.—The following extract from the Annual Report of the East Malling Research Station indicates the grouping of the most satisfactory stocks for apples in order of vigour.

A. Very Dwarfing Stocks.—Jaune de Metz Paradise (Malling No. IX), suitable for very quick cropping bush trees on good land, cordons and trained trees in small gardens.

B. Semi-Dwarfing Stocks.—Doucin (Malling No. II), suitable for moderate-sized, quick-cropping bush or trained trees, except for weak growing varieties.

C. Vigorous Stocks.—Broadleaved English " Paradise " (Malling No. I), suitable for bushes of the weaker-growing sorts, large permanent bushes, and even moderate-sized half-standard trees.

D. Very Vigorous Stocks.—The unnamed layered free-growing stocks (Malling Nos. XII, XIII, and XVI), suitable for the weakest varieties as bushes and for large standard trees.

The anchorage or roothold of the trees may be an important factor. Varieties which produce a heavy " head " such as Bramley's Seedling should, in exposed positions, be on vigorous stocks.

In places liable to late spring frosts the vigorous stocks which delay the opening of the blossom might be advantageous.

Pears and Plums.—Similar selections of pear, plum, and cherry stocks are being made, but the investigation of these is still in the initial stages. Ultimately a similar range of standard stocks may be obtained. At present the only satisfactory dwarfing stock for pears is Quince, of which the best variety appears to be Angiers Quince. Vigorous stocks for pears are at present provided by seedling stocks raised from Perry Pummace.

The plum stocks used at the present time are many and various; some are raised from seed and some by vegetative means. They do not, however, display the same range in vigour as apple stocks, but it has been shown at East Malling that some of them are semi-dwarfing.

The most satisfactory stocks for plums seem to be Common Mussel and Black Damas " C " (Malling selection). These can be propagated easily, are dwarfing in character, and do not show much incompatibility. For a vigorous stock a selection of Myrobolan, Myrobolan " B ", has given the best results.

Cherries.—Sweet cherries if required for standard trees are usually grafted, 6 ft. from the ground, on suckers or seedlings of the wild cherry. Acid cherries are frequently worked on the same stocks, but for bush or trained trees the Maheleb stock is used. Experiments have shown that wild cherry stocks can be easily raised by vegetative means; investigations on these points are still proceeding.

Planting.—Young trees should be planted in well-drained soil that has been well cultivated, and is free from perennial weeds. Prune the injured roots, and plant firmly. Planting should be done preferably in November, because the soil is warmer and roots will be developed quickly, which will be more likely to enable the tree to withstand dry conditions in the spring.

Pruning.—It is not always realized that the principles of pruning are comparatively simple. The objects of pruning are threefold:

1. To allow sufficient light and air for the normal development of stems and buds—this is impossible where growths are crossing or crowded.
2. To shape the tree.
3. To prune for fruiting wood.

In considering how these objects can best be attained it is appropriate to discuss them under the following headings, according to the type of wood on which the fruit is borne.

A.—BEARING ON YOUNG WOOD

Raspberries, black currants, loganberries, blackberries come in this group, as the fruit is borne mainly or entirely on the young wood made the previous season. The main object of pruning this group should be the encouragement of young growth by the cutting out of old wood, which is useless for fruiting. The winter pruning or cutting back of growth concentrates the energy of the shoots into a few buds, and does not retard growth as is often supposed, but rather results in the growth of a number of strong shoots.

Raspberries.—Most people are familiar with the pruning of raspberries, which consists in cutting out the old canes as soon after fruiting as possible, so throwing the energy of the plant into the young growths that are to bear fruit the following year. The young canes should be thinned out, leaving the strongest, which in a good plant should be about half a dozen. The tips may be taken off the young growths in the spring, when danger from severe frost has passed.

Loganberries and Blackberries should be treated similarly. Autumn fruiting raspberries bear on the current season's growth, and all canes should be cut down in the spring.

Black Currants.—These fruit best upon the wood of the previous season's growth, although to some extent spurs develop on the older wood. Two or three pieces of old wood should be cut out as low down as possible each year. No tipping or " spurring " should be done. It should also be borne in mind that black currants are benefited by comparatively heavy manuring, particularly with nitrogenous manures, as these encourage young wood, and, therefore, a larger fruiting surface.

B.—Bearing on Old Wood

In this group are found the majority of apples, pears, red currants, &c. The fruit buds of these trees are easily distinguished, and are usually borne on spurs. With the exception of varieties of apples mentioned later, the buds do not develop until the wood is two years old.

Apples and Pears.—In pruning mature apple and pear trees one should consider the growth that the tree is making, i.e. whether vigorous or weak, and also the readiness with which fruit buds are developed.

All the young growth should be cut back to two or three buds with the object of forming spurs, except those shoots which are required as " leaders ". A " leader " is a shoot that, owing to its position, is retained to carry on the main framework of the tree, and must be imagined as a branch in years to come. Very strong laterals should be cut off close to the main stem, otherwise a bunch of growth results.

With standard and half-standard apples the leaders need not be pruned, provided these are growing in the right direction, and are not too weak to develop a sturdy branch.

With bush trees and young trees generally, the strong leaders should have one-third removed to a bud pointing in the direction in which it is desired that the shoot should grow, e.g. if a leader is drooping it would be pruned to an upper bud; if too upright to an outer bud, &c.

Where leaders are weak they should be cut harder, to concentrate the small amount of energy in a few buds, and so obtain a stronger growth.

By leaving leaders as suggested, the dense thicket of young growth often seen is avoided—the energy of the tree is spread over a large number of buds, and fruit buds develop from wood buds lower down the leader. These buds would have been forced into growth if the leader had been cut hard. (Hard cutting is practised in forming a hedge, and a dense thicket of growth results.) Certain varieties are apt not to develop fruit buds all the way along the leader when the leaders are left two-thirds of their length; this points to the fact that they require pruning a little harder.

If a tree is growing very strongly it should be lightly pruned—possibly the leaders left altogether, as hard pruning will only accentuate the trouble. In order to promote early fruiting with certain varieties which are apt to make vigorous growth when young trees, or do not form spurs readily, it is often advisable to prune only the laterals to five or six buds for a few years. These long spurs may be gradually cut back as the tree gets into fruiting. Examples of varieties which often benefit from this treatment are Allington Pippin and Bramley's Seedling. Very strong growth may be due to the wrong stock when grafted, too much nourishment in the soil, or too heavy pruning. The pruning should be so adjusted as to encourage growth of medium strength, and keep a balance between fruit and wood.

Long spurs are apt to develop in the course of years, and a few of the largest of these should be cut back each year, so keeping the fruit buds close to the main branch. In a well-balanced healthy tree the branches should be furnished with spurs down to the main stem. Certain varieties of apples do not bear readily on spurs, but have fruit buds on the tips of the current season's growth, e.g. Worcester Pearmain; others bear partly on the young wood, e.g. Lady Sudeley. The habits of the trees must be discovered by observation. In these cases once the tree is formed the pruning resolves itself into thinning out crowded shoots, or shoots that are crossing over. Such trees can be allowed to have denser heads, as there are few if any spurs to die back.

With most varieties, young trees left unpruned give a quicker and greater show of blossom and a heavier and earlier yield. Similarly light pruning brings trees into earlier bearing. As, however, these results may be obtained at the expense of quality and size of fruit, and lead to broken branches, it may be advisable to sacrifice these small earlier gains. Young trees are better pruned severely for the first few years so as to form a stout framework capable of carrying heavy crops. As soon as this is accomplished it may be desirable to resort temporarily to light pruning to induce fruiting, but once the tree is in bearing it is not likely to produce excessive wood even if severely pruned.

Red Currants, unlike black currants, bear their fruit on the old wood, and should be pruned on similar lines to apples and pears, the laterals to two buds, but the leaders to about half their length, otherwise the wood develops spurs unevenly. The best type of bush is a basin-shaped bush with eight or nine main branches on a leg.

C.—Bearing on Old and Young Wood

Plums and gooseberries may be placed in this group.

Plums bear on spurs to some extent, depending on the variety, but the spurs die out after a few years, and the most satisfactory method of pruning, once the trees are formed, is to thin out crowded growths, tipping leaders where necessary to strengthen the growth.

Gooseberries.—For ordinary purposes, once the bushes are formed, gooseberries merely require the crowded growths spurring back or cutting out, and in the case of a very drooping variety, the leaders tipping.

Note. Winter pruning may be carried out from the time the leaf falls until the buds begin to burst in the spring—the actual time will be decided by spraying and cultural operations, and the weather.

Summer Pruning.—Summer pruning is hardly warranted, except for cordons and trained trees, and for the first four or five years with young trees. With certain varieties fruit buds may be induced, but the chief benefit derived seems to be letting in the light and air, and so obtaining better " finish " with dessert fruit, and ripening of the wood.

The most suitable time for summer pruning varies with the district, soil, variety, and season. Preferably the pruning should be done late enough to avoid secondary growth. Summer pruning consists in cutting the laterals (not required later as leaders) to about five leaves. In pruning trees in the winter that have been treated in this manner, the laterals should be spurred back as for other trees.

Forming a Young Tree.—In the case of apples the actual type of tree required, whether a standard, half-standard, bush, &c., would have been decided when grafting or budding by the type of stock used, but the principles of forming all the types are the same, whether dealing with apples, pears, plums, &c.

With a one-year tree or maiden, the tree is beheaded at a short distance above the height required later as a stem. Thus, in the case of a bush apple, the tree is beheaded at about 18 in. from the ground. If there is not sufficient growth in the first year to obtain the desired height, such as 6 ft. for a standard, the tree must be left another year, or longer, until the desired height is obtained. In pruning young trees a knife should always be used, and a clean cut made as close to the bud as possible.

The natural tendency of the sap is upwards, and by beheading the tree the sap is concentrated in the few buds at the top. The following year these buds grow out. These shoots must be imagined as main branches in years to come. Three or four branches are, however, insufficient to form the framework of a well-balanced tree, and these shoots are therefore cut back to about three buds, to a bud pointing outwards. This operation multiplies the number of shoots.

There are now sufficient shoots which, if properly placed, may be treated as leaders; shoots not placed conveniently should be spurred back.

The small twiggy growth on the stems of standards and half-standards should only be cut off gradually, as these assist in making a well-developed stem.

Young gooseberry and red currant bushes may be formed on similar lines.

Renovation of Old or Neglected Trees.—Pruning alone will frequently not suffice to bring these into the most profitable condition, and the necessary sprays should be applied in addition. When these trees are worth pruning, the first object should be to cut out dead or diseased wood, and any pieces that may be crossing over, the only pruning possible being a thinning of the crowded branches. In this connexion it is better to cut out a number of small pieces, rather than let in the light and air by removing two or three large limbs.

The right use of the saw is important, as ugly wounds open to disease are so frequently caused by its misuse. When sawing off a limb the cut should always be made close to the main stem (to avoid a stump) and the cut started underneath the branch first—this prevents a tear of the bark when the branch falls. The wound should preferably be smoothed over with a knife to promote quicker healing. In the case of plum trees particularly, the wound should be dressed at once with thick red lead or white lead paint to prevent the entrance of the spores of the silver leaf fungus.

Flowers

Hardy Annuals may be sown outside in most districts in March or early April. The seeds are better sown in drills than broadcast, as it is easier for the children to sow thinly by this method, and the thinning and weeding afterwards is facilitated. For small plants the drills may be 4 in. to 6 in. apart, for larger plants 9 in. to 1 ft. A few suitable hardy annuals are as follows:

Name.	*Height.*	*Colour.*
Asperula.	1 ft.	Blue.
Bartonia.	1 ft.	Yellow.
Candytuft.	6 to 12 in.	Various.
Chrysanthemum (annual).	9 to 12 in.	Various.
Clarkia.	2 ft.	Various.
Cornflower.	3 ft.	Blue, white, and pink.
Coreopsis	1 to 2 ft.	Various.
Eschscholtzia.	1 ft.	Various.
Flax.	1 to 1½ ft.	Scarlet.
Godetia.	6 in. to 2 ft.	Various.
Kaulfussia amelloides.	6 in.	Blue.
Larkspur.	1 to 3 ft.	Blue and pink.
Limnanthes.	6 in.	Yellow.
Love-in-a-mist.	2 to 3 ft.	Blue.
Lupin.	1 to 3 ft.	Various.
Marigold.	1 ft.	Yellow.
Mallow.	1 ft.	Various.
Mignonette.	1 ft.	Yellow.
Nasturtium.	1 ft.	Various.
Nemophila.	6 in.	Blue and white.
Poppy (Shirley).	1 to 2 ft.	Many shades.
Saponaria.	6 in.	Rosy scarlet.
Sunflower.	4 to 8 ft.	Yellow.
Sweet peas.	3 to 10 ft.	Various.
Virginian stock.	6 to 9 in.	White and red.

Half-hardy Annuals need raising in warmth; a temperature of about 60° F. is suitable for the majority. The seeds may be sown in pots or boxes of " open " soil. A suitable mixture, if obtainable, is three parts turfy loam, two parts leaf mould, and one part sand. In most cases if ordinary garden soil is used it will not stand frequent drying and watering without losing its texture and setting hard. Half-hardy annuals suitable for a school garden are as follows:

Name.	*Height.*	*Colour.*
Aster.	9 to 18 in.	From crimson to white.
Ageratum.	6 to 12 in.	Blue and white.
Antirrhinum.	6 in. to 3 ft.	From crimson to white.
Castor oil.	4 ft.	For foliage.
Nemesia.	9 to 15 in.	From crimson to white.
Salpiglossis.	3 ft.	Crimson, yellow, and blue.
Statice (sea lavender).	1 to 1½ ft.	Mauve, yellow, and white.
Stock (ten-week).	9 in. to 1½ ft.	Various.
Tobacco.	3 ft.	Various.
Zinnia.	1 to 2 ft.	From scarlet to white.

Hardy Biennials.—These plants generally take two years to complete their life history, and can usually be sown outside in drills during May.

Name.	*Height.*	*Colour.*
Canterbury bells.	2 ft.	Various.
Dianthus.	9 in. to 1 ft.	From dark crimson to white.
Forget-me-not.	9 in.	Blue.
Foxglove.	2 to 4 ft.	From purple to white.
Evening primrose.	4 ft.	Yellow.
Honesty.	2 to 3 ft.	Red, purple, and white.
Polyanthus.	6 in.	Various.
Sweet William.	1 to 2 ft.	Various.
Wallflower.	1 to 2 ft.	Various.

Wallflowers, polyanthus, and even Canterbury bells are not strictly biennials, but the best results are obtained by treating them as such. Perennial Gaillardias, Coreopsis Grandiflora, and Geums frequently die out in the winter, and are better treated as biennials.

Herbaceous Perennials.—Many of these plants may be raised from seed sown at the same time as biennials, but they are usually propagated by means of division. Cuttings of the soft young shoots of Michaelmas daisies and many other plants will strike readily in a shaded cold-frame in May. The soil for herbaceous plants should be free from perennial weeds and well worked. Planting is best done in November. A short list of plants is appended:

Name.	Colour.	Height.	Season of Blooming
Campanula	Blue.	6 in. to 3 ft.	Any.
Thrift or sea pink	Pink.	6 in.	June.
Evergreen candytuft	White.	6 in. to 1 ft.	April and May.
Christmas rose	White.	1½ ft.	Nov. to Jan.
Pyrethrum	Various.	1 to 2½ ft.	May and June.
Japanese anemone	White and red.	2½ ft.	Aug. and Sept.
Michaelmas daisy	All colours.	2 to 4 ft.	Sept. and Oct.
Scarlet lobelia	Scarlet.	3 ft.	Aug. and Sept.
Lupin	White, pink, blue, purple.	3 ft.	June.
Oriental poppy	Scarlet.	3 ft.	June.
Phlox	Various.	3 ft.	September.
Pæony.	Various.	3 ft.	June and July.
Tree lupin	White and yellow.	4 ft.	June and July.
Loosestrife	Rose.	4 to 5 ft.	June.
Sunflower	Yellow.	4 to 6 ft.	Aug. and Sept.
Oriental seakale	White.	5 ft.	June and July.
Golden rod	Yellow.	5 ft.	September.
Plume poppy	Cream.	5 to 6 ft.	June and July.
Everlasting pea	Purple.	6 ft.	July and Aug.

Roses and Flowering Trees and Shrubs.—Many roses and flowering shrubs can be very easily propagated in the school garden. Most of the vigorous varieties of roses will strike quite well from cuttings made with a " heel ", and will make good plants afterwards if liberally manured, although, of course, they are usually budded, and may be grafted (but only in heat under glass).

Common Shrubs.—*Deciduous one-year-old wood cuttings*, including flowering currant, buddleia, weigelia, some spiræas, syringa, and deutzia, should be planted in November. In the same month, *evergreen cuttings*—privet, laurel, veronicas, shrubby groundsel (*Senecio Greyii*)—may be planted on a north border, the growing point being left in the cutting. In May *layering* can be done with rhododendrons (usually grafted), berberis, dogwood, lilac, magnolia, Forsythia, nuts, and limes. *Seeds* of berberis, hollies, laburnum, plane, almonds (usually grafted), brooms and conifers require a sandy soil. (Many, however, do not come quite true from seed.) *Half-ripened wood cuttings* of yews, heaths, rock rose, veronicas, and Euonymus should be struck in a shaded frame in August.

The Pruning of Shrubs is carried out on the same principles as the pruning of fruit trees. It is first necessary to discern on which wood the blossoms are borne. Winter jasmine, Forsythia, Spiræa confusa, flowering currant, weigelia, and rambler roses flower on shoots of the previous year, and these should be pruned directly after flowering, to throw all the energy of the plant into the growth that is to produce the bloom next year. Buddleia variabilis (purple), bush and standard roses flower on the ends of the current year's growth. The old worn-out wood should be cut out in the spring, and the young growths cut back. Most of the evergreen shrubs and shrubs such as the berberis need little more than thinning or keeping in shape.

Pests and Diseases

In studying plant pests and diseases from the point of view of the cultivator, the difficulty frequently arises that a different treatment appears to be recommended for each trouble. The following classification may be found useful as a method of simplifying the problem for presentation to children:

CLASSIFICATION OF PLANT TROUBLES FOR TREATMENT

Group		Example	Treatment
Insect Pests.	Biting insects.	Caterpillars.	Use a stomach poison such as lead arsenate.
	Sucking insects.	Greenfly.	Use a contact wash such as nicotine and soft soap, or an egg-killing wash in winter.
	Insects in the ground.	Wireworm.	Thorough cultivation, chickens, &c.
Fungoid Diseases.	External.	Rose mildew.	Use some form of sulphur or copper sulphate.
	Internal.	Silverleaf.	Eliminate source of infection. Protect all wounds.
	In the ground.	"Clubroot" in cabbage.	Lime, rotation of crops.
Bacterial Diseases.		"Stripe" in sweet pea.	Grow plants sturdily with an adequate supply of potash.
Virus Diseases.		"Leaf roll" in potatoes.	Propagate only from clean stock. "Rogue" plants regularly.

All plants should be given the best possible conditions to grow healthily.

It is probably as well to work out the characteristics and life history of a typical example of biting insect, sucking insect, &c., for each group, and then if time permits deal with any local trouble of special interest. The leaflets issued by the Ministry of Agriculture will be found exceptionally useful when dealing with this part of the work.

There are, of course, exceptions to the classification suggested, e.g. it would be impossible to spray cabbages with lead arsenate against caterpillars if the cabbages were to be of any use for human consumption afterwards. It should also be noted that although sulphur is a fungicide it is used against certain " mites " such as the " Big Bud " mite and " Red Spider ".

Winter Spraying.—Winter spraying should be carried out when the trees are quite dormant from mid-November to the end of January. The objects of winter spraying are: (1) to clean the trees; (2) to kill the eggs of such insects as Apple Sucker, Aphides, Mussel Scale, and a number of caterpillars.

List of Winter Sprays.

			Approx Cost per Gallon
Spray W. I.	Tar distillate.	Buy ready prepared	—
Spray W. II.	Quick lime	15 lb.	1*d.*
	Water	10 gallons	

The most satisfactory general spray is one of the tar distillate sprays (Spray W. I.). These should be used at a strength of 7½ per cent (i.e. ¾ gall. to 10 gall. of water) for currants, gooseberries, and plums; at 10 per cent for apples, where caterpillars are numerous, or 7½ per cent against aphis only. Spraying with one of these washes should be carried out annually as a matter of routine.

A modified tar distillate spray is now available, made as a result of work carried out at Long Ashton Research Station. This spray is capable of killing a considerable proportion of Capsid Bug eggs, and should be used where Capsid Bugs are troublesome. It is more expensive than the ordinary tar distillate spray, and there is no object in using it unless Capsid Bugs are present.

Spring Spraying.—The dates for spraying are governed by the growth of the trees. The two chief periods for spraying are: (*a*) just before the blossoms open (" pinking " stage in apples); (*b*) just after the petals fall. At this time of the year, however, it is necessary to exercise discretion in the choice of the spray to be used, as certain varieties of fruit-trees are injured by the sprays which are most effective. For these reasons, details are given separately of the procedure advised for the control of the three most important plant troubles of the spring and summer, namely: Apple and Pear Scab, Capsid Bug, and American Gooseberry Mildew. A few notes on Gooseberry Sawfly Caterpillars, Onion Mildew, and Aphides are added.

List of Spring Sprays:

			Approx. Cost per Gallon.
Spray S. I.	Copper sulphate	¾ lb.	½*d.*
	Quick lime	2½ lb.	
	Water	12 gallons	

This is a modified form of Bordeaux Mixture with excess lime in the ingredients. It should be mixed just before use in a wooden or earthenware vessel.

			Approx Cost per Gallon.
Spray S. II.	Nicotine	3¼ oz.	1½*d.*
	Soft soap	4 lb.	
	Water	40 gallons	
Spray S. III.	Lime sulphur		—
Spray S. IV.	Lead arsenate		—
Spray S. V.	Liver of sulphur	1 oz.	½*d.*
	Water	3 gallons	
Spray S. VI.	"Katakilla"		—

(Sprays S. III, S. IV, S. V, and S. VI should be bought in concentrated form.)

Apple and Pear Scabs are caused by a fungus which injures the leaves, shoots, and fruits. The affected fruits become spotted, or cracked in the case of a bad attack. The young wood is blistered, and the leaves covered with sooty spots. The disease is carried over the winter on the diseased wood and leaves. As much as possible of the affected wood should be cut off and burnt, and the leaves dug in or swept up and burnt. In view of the increasing trouble caused by *Red Spider* on fruit trees, use lime sulphur where possible, as in addition to controlling apple and pear scab it also reduces Red Spider.

At the "pink bud stage" spray all varieties with lime sulphur at 1 in 30. After petals fall, a further spraying should be given in varying strengths according to the varieties as follows:

i. Lime sulphur, 1 in 100: Cox's Orange Pippin, Charles Ross, Lane's Prince Albert.

ii. Lime sulphur, 1 in 80: Lord Grosvenor, Blenheim Orange, Wellington, Newton Wonder (not Bordeaux mixture).

iii. Lime sulphur, 1 in 60 (not Bordeaux Mixture for these varieties): James Grieve, Allington Pippin, Lord Derby, Lady Sudeley, Annie Elizabeth, Beauty of Bath, Gladstone, King Edward.

iv. Lime sulphur, 1 in 60: Worcester Pearmain, Bramley's Seedling, Grenadier, Emneth Early.

N.B.—Stirling Castle should not be sprayed at the "petal fall" stage.

In the case of a bad season or susceptible varieties a third application may be necessary.

Scab is usually sufficiently serious to necessitate annual spraying. (For further information see Leaflet No. 131 of the Ministry of Agriculture and Fisheries.)

Capsid Bug injures the terminal leaves and buds, and in the case of apples seriously deforms and marks the fruit. Spray with nicotine and soap (Spray S. II), using a coarse nozzle and considerable force at period (*a*), or if a serious attack at periods (*a*) and (*b*). These instructions do not apply if spraying has been carried out in the winter with a modified tar distillate spray, as recommended under winter spraying.

It will be seen that in order to produce first-class apples and pears, at least three sprayings are necessary annually, i.e. a tar distillate spray in the dormant period and two sprayings with lime sulphur.

American Gooseberry Mildew occurs first as a white mildew on the undersides of the leaves and on the fruits. Later the white mildew turns to a brown felt-like covering, which can be easily peeled off. Minute black specks are embedded in the brown mass; these are the resting spores (seeds). To prevent the resting spores falling to the ground all affected shoots should be " tipped " early in September and the prunings burnt. As a preventive, spray gooseberries at periods (*a*) and (*b*) with lime sulphur, 1 gall. to 29 gall. of water, *excepting* the following varieties: Berry's Early (Keepsake), Cousin's Seedling, Lancashire Lad, Crown Bob. The strength of spray given above would injure these varieties, and it is, therefore, advisable to reduce the strength by one-half, i.e. ½ gall. of lime sulphur to 29 gall. of water. Certain other varieties, known as the sulphur varieties, must not be sprayed with lime sulphur at all. Of these the only common one is Golden Drop (yellow rough).

It should be noted that persons growing gooseberries or currant bushes for sale are under obligation to notify each occurrence of American Gooseberry Mildew to the police or the Ministry of Agriculture.

Gooseberry Sawfly Caterpillars usually appear in large numbers when the fruit is on the bushes. It is therefore impossible to use a stomach poison such as lead arsenate. At this stage " Katakilla ", a proprietary article which is non-poisonous and does not mark the fruit, may be used, or one of the new Pyrethrum Sprays.

Rose Mildew, *Onion Mildew*, *&c.*, can be readily controlled by dusting the plants with flowers of sulphur, or by the use of liver of sulphur (Spray S. V).

Aphides.—These should be dealt with by using nicotine and soft soap (Spray S. II) in the spring and summer.

Big Bud on black currants is caused by a small mite, and one infested bud may contain 5000 mites. There is *no cure* for this pest, but the bushes may be kept clean by observing the following precautions:

(i) Badly affected bushes should be burnt. (ii) Bushes should only be bought or propagated from clean stock. (iii) Bushes should be sprayed with lime sulphur at a strength of 1 in 15 when the leaves are about the size of half a crown in the spring. For the variety Edina, a strength of 1 in 20 should be used.

How to Spray.—It is most important to spray trees *all over*, especially the twigs. A fine mist-like spray is usually best, both for the sake of economy and to ensure thorough wetting of the whole surface. Sprays W. II, S. II, and S. VI are exceptions to this rule, as these require a coarse spray applied with considerable force. The quantity of spray required will depend on weather conditions at the time of spraying, and the size of the trees. Ten gallons will spray approximately:

15 to 20 full-grown currants, gooseberries, &c.
10 apples, plums, &c., 9 ft. in diameter.
4 " " " 15 " "
2 " " " 21 " "

Silver Leaf.—This fungoid disease attacks such a wide range of trees and shrubs that, although there is no means of control by sprays, it seems appropriate to add a few notes giving recent information on the subject. Silver Leaf is caused by a fungus which may ultimately kill the tree. Plums are more liable to attack than any other tree, and the Victoria plum is the most susceptible variety.

The first sign of the disease is usually the appearance on a branch of foliage with a silvery or leaden sheen. After a time the branch begins to die back, and as branch after branch becomes attacked large portions of the tree die. The length of time between the first silvering and the death of the tree varies with the tree and the extent of the attack. After the death of a branch a purple fungus appears and forms flat incrustations. This is the Silver Leaf Fungus, and it is at this stage that it bears spores (seeds) and is infectious. The following measures of control may be taken:

1. The spores are probably only able to enter the tree through wounds. All wounds should therefore be dressed with some protective substance. Thick white lead or red lead paint has been found the most satisfactory.
2. The first silvered shoots should be cut off well below the silvered leaves, and below the brown stain which indicates the presence of the fungus in the stem, and burnt.
3. Heavy pruning of plums should be done in June, as there is less likelihood of infection at this time of the year, and the tree being in active growth at once forms a " gum barrier " below the cut surface, through which infection cannot take place. Nevertheless, the wounds should be dressed in the manner indicated above.
4. If a young active tree is attacked there is a good chance of recovery, and a dressing of manure may help the tree to conquer the fungus.
5. Badly infected old trees which are dying back should be *dug up* and burnt.

The Silver Leaf Order, 1923, makes it compulsory for all dead wood to be cut out of apples and plums by 15th July each year and burnt. Where the whole tree is dead, it must be dug up and the tree and the roots burnt.

Soils and Cultivations

Children should investigate the origin of soils, comparing different types and fertility, and the nature-study lesson might be supplemented by a study here of the dwellers in the soil, such as earthworms, beetles, ants, centipedes, and millipedes, and a brief outline of the work of bacterial organisms in the soil. The effect of cultivations on soil moisture and tilth draining, double digging, rolling and hoeing, and the modifications of these operations on different soils and in different seasons, will form excellent experiments. Especially should it be emphasized that cultivations are more important than manuring, and that the soil is in itself a storehouse of food, and a factory.

Manures and Manuring. (This would be one of the most important series of lessons in the course.)

The objects of manures and manuring are: (*a*) to supply plant food and supplement that which is already in the ground; and (*b*) to improve the mechanical condition of the soil, and to set free plant food.

The absence of " sourness " or acidity in soils is essential for the growth of most crops, and for the full value to be obtained from cultivations and manuring. A sour soil may be detected by the presence of the weed, sheeps' sorrel, and by the poor tilth of a heavy soil. The ordinary test for chalk may be made with hydrochloric acid (1 part concentrated acid to an equal quantity of distilled or rain water).

The Eight-plot Test.—A large number of plant foods are obtained by the plants from the soil, but apart from lime only three are likely to be deficient—nitrogen, phosphorus, and potassium. None of these is any use alone, but has to combine suitably with other elements to give solid compounds. For nitrogen, sulphate of ammonia or nitrate of soda is a useful form. Superphosphate of lime is a compound containing phosphorus, while sulphate of potash contains potassium.

A soil analysis is of little practical value in finding out what plant foods a soil requires, as, although an analysis will indicate the total amount of nitrogen, phosphorus, or potassium in the soil, it does not show the quantity of these plant foods that is in a state ready for the plants to use—what is known as the " available " food. A test has therefore to be made on the ground or in pots or boxes.

The idea of the eight-plot test is to detect any well-marked response to nitrogen, phosphorus, or potassium. A box may be divided into eight compartments, each about 8 in. by 8 in. by 8 in., and a few holes made in the bottom of each for drainage. (Alternatively eight similar boxes or flower-pots are placed in a group.) The soil to be tested is then put into the box, being distributed as evenly as possible over the eight compartments. The compartments are manured according to the scheme below:

1	2	3	4
P.	P.K.	K.	
N. P.	N.P.K.	N. K.	N.
5	6	7	8

N = Nitrogenous Manure.
P = Phosphatic Manure.
K = Potassic Manure.

Seeds of a suitable crop, e.g. oats, mustard, barley, or turnips, are planted in the box, and when germinated are thinned to give the same small number of plants per compartment.

By comparing the growth and crop obtained in the pairs of plots 1 and 5, 2 and 6, 3 and 7, 4 and 8, the influence of N is estimated. Similarly for the effect of P, there are the four pairs 1 and 4, 5 and 8, 2 and 3, 6 and 7; while for the effect of potash there are the pairs 1 and 2, 3 and 4, 5 and 6, 7 and 8.

The test could usefully be carried out with a very poor soil (e.g. sand mixed with a little soil), with some of the school garden soil, and with other soils from the neighbourhood. It might also be possible to do exactly the same test on a larger scale in the garden itself, or it could be performed year after year on small grass plots, cutting and weighing each at intervals.

As it is necessary to exaggerate the results, it is well to give heavy dressings of manures, e.g. sulphate of ammonia at the rate of 3 cwt. per acre, superphosphate 6, sulphate of potash 3.

If performed in the garden there is no need to keep to the actual plan suggested above. Thus, a row of potatoes could serve as one of the compartments requiring eight rows altogether. But, however arranged, the manures must be carefully weighed out and distributed as evenly as possible, without overlapping on to adjacent plots. In all cases notes should be kept on the progress of the crop, and at the end the weights obtained for each treatment recorded.

The eight-plot test in boxes, especially of the same soil, if used a number of times, keeping the manurial treatment the same (i.e. always having the same compartment of soil untreated, &c.), would enable the typical effects of the three manurial elements to be demonstrated ocularly. Deficiency of nitrogen compounds results in a stunted growth, and a yellowing of the leaves from the midrib outwards, the veins themselves remaining green. A large supply of nitrogen causes rank growth, a dark-green colour, and late ripening.

Plants from the plots well supplied with phosphate would show a well-developed root system; their earlier ripening might also be observed. Phosphorus deficiency is rather difficult to detect, but in the case of cabbages, sprouts, &c., is usually shown by a bluish appearance of the foliage. Deficiency of potassium is often shown by a yellowing of the leaf from the margin inwards; the edges turn brown and produce a condition commonly known as " scorch ". Certain diseases, however, and also waterlogged soil may produce a rather similar effect.

Special Requirements of Certain Crops.—So far as their nitrogen requirements are concerned the leguminous species (clovers, sainfoin, lucerne, beans, peas, &c.) are a class apart. Examination of the roots will show the presence of little nodules about the size of a pin's head. About forty years ago it was discovered that they are produced by particular kinds of bacteria. These are extraordinary in their ability to utilize the gaseous element nitrogen (which constitutes four-fifths of the atmosphere) for the formation of nitrogenous compounds. In some way or other these are passed on to the infected plant, which thereby is rendered independent of the nitrogenous compounds in the soil which other crops must have. This happy combination of bacteria and plant is an example of what is called " symbiosis "; it might be termed " beneficial parasitism ".

Not only is the leguminous plant kept supplied with its nitrogen compounds by the bacteria, but the roots on decay add to the supply of available nitrogen in the soil. This explains the great benefit to succeeding crops of including a " clover ley " in the rotation, or the benefit derived from putting land down to lucerne or sainfoin for a few years. In recent years it has been found possible to prepare pure cultures of the bacteria responsible for nodule formation, and in the case of lucerne this has found a practical application by adding them to the seed before sowing, so making certain that after germination the lucerne plants become infected. In this way chances of failure are greatly reduced.

Since leguminous plants can get their nitrogen in this way, their special needs are phosphates and potash. This applies especially to those which have a good root system and a long period of growth, e.g. clover, lucerne, and sainfoin. Others grown as annuals with only a few months in which to mature will benefit from a dressing of nitrogenous artificial; further, most legumes respond well to dung.

" Root " crops—mangolds, potatoes, beet, carrots, &c.—contain large amounts of potash. Their chief needs are nitrogen and potassium.

The cabbage tribe has a special need for phosphorus in addition to nitrogen.

Although there exist these special requirements of certain soils and certain crops, since the object of the cultivator should be to maintain or increase fertility, manuring is determined rather by the level of production aimed at than by the type of soil. These special needs should be met by a little extra of the particular constituent and not by the omission of the others. Thus there would be a tendency to use rather larger dressings of potash manures on a light and chalky soil and of phosphatic on a heavy soil.

How the Plant Foods may be Supplied.—The plant foods may be supplied by means of organic manures such as farmyard manure, chicken manure, fish meal, &c., or by what are known as artificial manures. The bulky organic manures such as farmyard manure are invaluable for improving the texture of the soil, making a light soil more retentive of moisture, and a heavy soil more workable, and breaking down to form what is known as humus. All the necessary plant food can be both easily and cheaply supplied by means of artificial manures, but if these are continually applied the soil loses its texture and becomes unworkable. On the other hand, experiments have shown that the most economical method of manuring is farmyard manure, or some bulky organic manure supplemented by suitably balanced artificials.

Farmyard manure is frequently difficult to obtain, and its place may be taken by digging-in a catch crop of some cheap, quick-growing crop such as mustard, which is known as green manuring. Much of the garden rubbish can be dug into the soil with advantage, provided the material is not diseased, when it should be burnt.

Propagation

This subject could be usefully extended in many school gardens. The method of increase of wild and cultivated plants is frequently the factor which governs the plant's success or failure in its struggle against other plants.

Vegetative Propagation by cuttings, layers, suckers, bulbils, budding, grafting, &c., usually ensures the same characteristics in the offspring that were present in the parent, and is with some plants a quicker method than from seed (e.g. apples).

Propagation from Seed.—Cross pollination is frequent, hence the progeny are not true to type. Is it possible to ensure self-pollination? Some plants are self-sterile.

With older pupils an introduction to the laws of inheritance might be possible.

CHAPTER IV

Experimental and Demonstration Work

The following experiments and demonstrations have been found useful and interesting, and many can be carried out by the children either in school or in their own homes.

Seeds and Seed-sowing

1. Sow seeds at different depths.
2. Weigh bean seeds, sow a given number of large seeds in one row, and the same number of small seeds in another.

3. Make autumn and spring sowings of broad beans or peas, side by side.
4. Thin seedlings to different distances apart.
5. Sow seeds under good and bad cultural conditions.
6. Demonstrate " strain " by sowing seeds of the same variety from different sources.
7. Sow old and new seeds of such crops as peas and parsnips.
8. Plant large and small tubers of potatoes.
9. In the south of England compare home-saved potato tubers with Scotch or Irish.
10. Compare cut tubers with whole tubers (the cut tubers should not be dipped in ashes or lime, but allowed to dry slowly).
11. Compare " sprouted " potato tubers with unsprouted tubers.

The Pollination of Fruit

12. Cover some apple blossom buds with paper or muslin bags before they open—note percentage of fruit set inside and outside the bags.
13. Note the relative flowering periods of different varieties of apples, pears, and plums over a series of years.

Root Stocks

14. Compare the habits of growth of different apple stocks.
15. Plant four trees the same age and variety under similar conditions on four different stocks. Each year record the growth, cropping, &c.

Pruning

16. Leave some trees unpruned. Prune others lightly and some hard. Record growth, crops, and quality of the fruit.
17. Summer prune a portion of an apple tree at intervals of a week from the beginning of July. Note the results.

Flowers

18. Sow seeds of half-hardy annuals in pots or boxes in soil from the garden, and in a suitable compost.
19. Dig up daffodil bulbs at intervals of a fortnight after they die down. When do they start rooting again?
20. Make cuttings of various shrubs with and without a heel.
21. Make a note of the wood on which different shrubs flower.

Soils and Cultivations

22. Try alternative methods of cultivation; double dig one portion of a plot, single dig the remainder, hoe one half of a plot twice as often as the other, roll a portion of a plot, &c.

Manures and Manuring

23. Test the school garden soil for the presence of chalk. The children should bring samples of soil from home and from neighbouring fields. It may be possible to make a map of the district, indicating soils with a deficiency of chalk.

24. Lay out an eight-plot test or manure portions of the plots in different ways, e.g. with organic and without organic manures, &c.

Propagation

25. Propagate different plants in as many ways as possible, e.g. by seed, division, cuttings, &c. Which is the most successful for each plant? Is there any difference in the result of the methods?

26. Bud and graft apples, pears, or plums. Is there any difference in the result?

Spraying and Plant Troubles

27. Find the eggs of greenfly, &c., on trees, bring shoots indoors and hatch them out.

28. Spray some trees, leave others unsprayed. Collect eggs from sprayed and unsprayed trees, and endeavour to hatch in school.

29. Collect caterpillars, chrysalids, &c., and breed in school.

30. Make a collection of beneficial insects.

31. Compare the growth and crop of sprayed and unsprayed trees.

Note-books and Records

Records of all the demonstration work in the garden should be carefully made. Some teachers might feel that some of the lessons should be recorded in arithmetic books, others in rural science, &c.

A plan of the garden and methods of cropping is essential, also a crop record giving the date of sowing, appearance of seedlings above the ground, date of harvesting and the condition and value of the crop. A copy of the seed order and a balance-sheet at the end of the year should also be included.

Other work in the garden will provide material for lessons on nature study, drawing, composition, elementary chemistry, and biology, and useful experience in making equipment such as frames, potato-trays, labels, boxes, &c.

CHAPTER V

Calendar of Work

The suggestions in this calendar are for the ordinary routine work, quite apart from any special course.

January.—Complete the digging, pruning and winter spraying. Renovate paths. Put potatoes in a light, frost-proof place to sprout. Plan the cropping for the year. Draw plans of the garden. Make out the seed order. Arrange manuring experiments.

February.—Apply artificial manures before sowing. If the ground is in good order prepare seed-beds and sow broad beans and peas. In the middle of the month sow onions and parsnips, the latter are best sown in clumps of 3 or 4 seeds every 10 in. in the row. Sow celery in frames or in school. Plant shallots. Layer quince stocks. Earth up plum stocks. Start crop records, entering all sowings. Prepare labels for experimental plots, vegetables, &c.

March.—Hoe the plots whenever the weather and ground are suitable. Sow Brussels sprouts, cabbages, cauliflowers, leeks, and lettuces. Late in the month sow globe beet, shorthorn carrots, turnips, &c. Prick off celery. Sow half-hardy annuals indoors.

April.—Thin seedlings. Sow hardy annuals. Prune roses. Plant out potatoes. Make sowings of broccoli, Christmas cabbage, and at the end of the month kale and sprouting broccoli. Make further sowings of lettuce. Sow spinach, radishes, &c. Lay apple stocks.

May.—Spray apples with lime sulphur at " pink bud " stage at 1 in 30, and again after petal fall according to variety. Thin seedlings. Plant out brassicas, stake herbaceous plants and peas. Hoe regularly. Sow maincrop carrots and beet, and at the end of the month French beans, runner beans and marrows, depending on the district. Prepare celery trenches, sow radishes or lettuces on the ridges. Sow biennials such as Sweet Williams, Canterbury bells, wallflowers, &c., and any herbaceous perennials to be raised from seed.

June.—Stake all plants that need it, including peas and beans. Earth up potatoes. Regularly hoe all the ground. Sow lettuces thinly and thin out in the rows; do not attempt to transplant if the weather is dry. Layer strawberries on pots after fruiting. Bud roses.

July.—Continue hoeing. Spray potatoes twice with Bordeaux mixture. (The date will depend on the district.) Summer prune fruit-trees towards the end of the month. Bud roses and fruit stocks. Plant out winter greens as second crops after early potatoes or early peas. Shorthorn carrots or globe beet may be sown as second crops. Sow spring cabbage at the end of the month. Insert half-ripened wood cuttings (in shaded cold-frame) of evergreen shrubs.

August.—Arrange for the garden to be attended to during the holidays and crops harvested. Earth up celery.

September.—Sow winter onions and lettuces. Clear and dig ground roughly as the crops are ready. Earth up celery for the last time. Plant bulbs outside and in pots. Prune rambler roses.

October.—Continue digging and double digging. Winter pruning may be started. Complete planting of bulbs. Plant out wallflowers, forget-me-nots, &c.

November.—Sow broad beans and peas for a spring crop where the conditions are suitable. Continue pruning. Make cuttings of fruit bushes and shrubs. Plant fruit-trees. Divide herbaceous plants. Start spraying with winter wash after the middle of the month.

December —Continue work outside not already completed. Make a balance-sheet for the year.

HANDWORK

BY

HERBERT TURNER

HANDWORK

CHAPTER I

Junior Handwork

One of the difficulties of school practice is to arrange, from department to department, a reasonable continuity in the teaching of the subjects in the curriculum. Constant consultation between the staff of junior and senior schools is a real necessity to ensure anything like a continuous scheme operating smoothly, efficiently, and with the minimum of waste in time and energy.

In respect of practical work this is especially true. In the past, children have come into the handicraft room unable to understand a carpenter's rule, or the simple elements of drawing. This was due partly to an absence of consultation between the staff of the junior school and the handicraft staff.

It is essential that practical work occupying a considerable space in the curriculum of the junior school should be of such a character that it forms an effective introduction to the work of the senior school, besides providing a reasonable training in itself. To make this effective, there must be co-operative planning so far, at least, as general outlines are concerned.

The forms of handwork that can best be practised in the junior school will comprise paper and cardboard work, raffia work, basketry, leather work, weaving, clay modelling, toys and games. Although the children are still in the imaginative and self-expressional stages, yet as they progress through the junior school, they gradually arrive at a stage when their mental needs call for something that has connexion with reality. It is this fact that makes it reasonable to say that the crafts which have the sanction of history, and which are still practised, should form the foundation of the handwork in junior schools.

There are many forms of handwork, but it must be insisted upon that handwork is not a loosely woven collection of various forms that can be used indiscriminately. There must be a backbone of purpose running through a scheme that will determine the strength and the character of the practical instruction, and there must be a line of approach to these ends that is continuous. This is more easily effected through some forms of practical instruction than through others, and the two aspects of practical instruction that are suggested as most suitable are paper and cardboard work, and practical drawing.

Paper and Cardboard Work.—This form of practical instruction offers the most fertile field for the training of children in junior schools. Paper and cardboard work has already been done in infant schools on expressional lines. The junior school is rapidly growing out of that stage in its evolution, and feels the need of a form of practical work that will fit its environment. The centre of interest is shifting from the inner life of creative imagination to that of the outer and harder experience of contact with life. The work done at this stage can proceed along two definite lines as follows: (*a*) the making of articles of real use; and (*b*) the illustration of school subjects.

The number of utilitarian objects that can be made in paper and cardboard is comparatively few, but there are enough to form satisfactory schemes throughout the junior school. Under the heading (*b*) paper and cardboard can be used to illustrate history, geography, arithmetic, geometry, design, and literature.

Throughout the whole of this work, the ruler is continually called into use, and without giving an excess of formal tuition the children are trained to measure accurately and intelligently. Colour is increasingly used, and in paper and cardboard work can exercise a great influence on development. Space is too limited to give detailed schemes, but work in these materials will include paper tearing, cutting, and modelling, picture making, design in paper, cardboard modelling, the making of cardboard toys, the illustration of history, geography, and literature, the preparation of coloured covering papers for boxes, calendars, photo frames, and so on.

Later, during the years immediately preceding the transference to the senior school, juniors should do work that may be described as an approach to bookbinding. Much work that involves bookbinding processes can be incorporated in the making of calendars, writing pads and cases, blotters and blotting pads, portfolios, box and other files, which is of great value in the training of young children. This training consists in measuring, planning to fit purpose, manipulation of tools and materials, the use of colour, and the place of design. A cardboard course, such as outlined, is a natural and a necessary introduction to bookbinding.

Raffia Work.—This has a lineage reaching probably far beyond history. Its beginnings belong to the childhood of the world, and this makes it suitable for the child stage of the present-day pupil. Work in raffia has been considered inadequate as a form of training. That was when no attempt was made to make objects that had a real purpose in life. The newer conception of handicraft, generally, calls for the making of real things. As now practised, raffia work is one of the most useful and fruitful forms of handicraft that can be practised, whether we consider it as winding, weaving, plaiting, Indian basketry, or sewing in raffia. Planning, construction, pattern design, and colour work are part of the whole scheme and provide opportunities for child development that were not thought of previously.

Basketry.—This is one of the very oldest crafts. As a craft for junior children it is more limited than raffia work, for the material is more fitted to the fingers of seniors. Cane basketry is generally meant when speaking of " basketry ". Willow basketry has possibilities that are confined to the senior school, by reason of the greater intractability of the materials, and of the greater difficulties of construction. Even in senior schools basketry will have a limited use, for there is a limit to the variety of objects that can be made. Articles such as teapot stands (with a tile), mats, tea trays, baskets with plywood bases may be worked, and will supply the training that is desired.

Leather Work.—Here again we are in touch with one of the oldest crafts mankind knows. Leather work may have greater value in the senior than in the junior school. Nevertheless, it can be included for some of the older juniors. It is often said that leather work is too expensive for school use. This is true only if the least expensive leathers have been neglected. These are the " soft " leathers, split suèdes and persians, which afford the best training for juniors.

If these leathers be used, and the objects planned in detail on paper or thin card, if the ornament used be thonging, weaving, stencilling, stitching, cut-outs, overlays, and similar ornament, leather work can be of the greatest possible use in cultural education through craft, and provide an inexpensive craft for the junior school.

Weaving.—This is a very old craft rich in historical associations, and it provides a fine training. Small looms can be home-made, some even by the juniors. On these looms can be woven ties, belts, hat bands, reins, and similar objects. In the weaving can be included planning, design, and colour work. The smaller objects, too, have this advantage, that they do not necessitate that monotonous repetition of shuttle work that the larger pieces often call for. The training is in the setting up of the loom, in the design, and in the colour planning called for.

Clay Modelling.—Clay is a natural material, easily obtainable, and easily manipulated. Finger skill is trained, forming a valuable medium for the expression of a child's feeling for art form. Its value is greatest if taken on art lines, and if it is associated with the reproduction of real objects.

Toys and Games.—The making of toys and games can form a most valuable addition to the handicraft of the junior school. They provide a source of real pleasure to the children. The toys can be of the soft kind; i.e. made of material and stuffed with flock, rag, wadding, packing material, or upholsterer's fibre. These are most suitable for the infants to play with; they can be made by the older juniors. Other toys can be made of plywood, stained and painted, and cut with fret saws. Boys love the fret saw, and toys will be a more suitable objective for them than much of the fretwork that is unfortunately prevalent. Movable toys can be made of fretwood, and provide admirable opportunities for planning, and for initiative. Toys can be made in cardboard also, and much useful measuring, drawing, and colour work can be done.

Games call for many materials, and should be considered in the building up of a scheme of junior handwork. Puzzles of various kinds can be included in such a course.

Design.—One of the striking features of modern handwork has been the use of design and colour. This has multiplied its training value enormously. Design calls for that creative action without which development does not take place. All types of practical work call for a kind of design that is within the powers of junior children. Pattern work supplies this need. It is dependent upon the repetition of one or more simple elements which have little meaning in themselves, but, repeated, give rise to valuable pattern that is eminently suitable to the ornamentation of objects made in the handicraft room. It emphasizes structure and shape, and gives ample opportunity for colour work. Stick printing, for example, is an admirable form of art training for juniors, which later can be developed into line and wood-block printing. In leather craft also some of the older juniors can be shown how to make, and then to use, ornamental punches to form punched designs.

Stencil plate making is also an example of similar design; small units can be cut which, repeated, make excellent design. Cover papers may be made in this way with which to cover boxes, calendars, photograph frames, &c. The use of squared paper for the making of design is recommended. Strength is induced, and the right structure of design, its planning, and its restraint is clearly indicated. Coloured paper cut to various shapes can be used to make patterns. All children can compose design by such means.

The Choice of Handicraft.—It is not suggested that all these forms of handwork will be practised in any one school, at any one time. Sometimes one form will be taken for one year, and another taken the next year. It may be that one form will be taken for one term only, thus getting three kinds in practice in one year. It is, however, recommended that paper and cardboard work should always, in one form or another, be included in the handwork programme of the junior school. The other kinds can be used in addition, as time and other circumstances allow.

The Time Allowed.—It has been found of value in junior schools to use as much as four hours per week for practical work including drawing. To employ this time to the best advantage, it is advisable to take the art on a craft basis. If handwork and art are taken as one, then adjustments of time, giving mutual help, can be made in one direction or the other.

CHAPTER II

Handicraft in Senior and Central Schools

It is of little avail to introduce any form of handicraft into school life, unless a clear and definite conception of its value be recognized, and the means of determining that value be known. Vagueness in the conception of underlying principles prevents energetic development of the work, and militates against ultimate success.

The reasons that can be given for the practice of school handicraft fall into two main classes. (1) *Material reasons*: (*a*) it cultivates manual dexterity, making children more able to take their place in life as units in industry; (*b*) it enables children to make articles of use that serve real purposes in the home, or in their lives, or in school; (*c*) it makes children more " handy " and better able to do the " odd jobs " of life; (*d*) because of its active nature, it is a valuable factor in physical development.

These are all true and their value is self-evident. At the same time it cannot be said that they cover the whole ground.

2. *Reasons concerned with mental growth.* Another view, held by a large class of educationists, is that: (*a*) handicraft is a valuable factor in the acquisition of knowledge. It uses the child's activity in creating interest in school subjects that would otherwise be looked at with indifference; (*b*) it broadens the intellectual outlook by this greater interest, and consequently greater knowledge, which gives a wider contact with the academic work of the school; (*c*) because it makes undoubted demands upon the qualities of perseverance, resource, initiative, patience, reasoning, and thoughtfulness it makes for the development of greater mental power, and its reactions are beneficial to intellectual development.

Craft Standards

It can be said, and often is said, that we are not teaching craft *as* craft; that we are not engaged in training craftsmen; that, as our job is to develop the powers lying latent in children, the craft product does not materially matter—that all that matters is development in mental and moral power.

That many children do go no farther than this, for a long time, is one of those real facts that cannot be ignored. To say, however, that we need not do good craft work, that bad work must be excused, and that the craft value may be ignored, is really playing with the truth, and certainly encourages a wrong standard. To ignore the importance of good craft results is to minimize the value of craft attainment.

It is true that development is the primary aim, and is fundamental; and that craft as craft is secondary and incidental; but even development will flow better through perfect than through imperfect channels. It is essential, therefore, that a craft standard be high, and that the best possible work should be expected from each child.

To make this our aim is not to set a standard to which all children may arrive. Capacity in children varies considerably, and the wise teacher will be careful not to discourage the slower and less capable child by adopting a rigid and unalterable standard for all. Much discretion, however, is required in making exceptions, for there is a real tendency to consider the child's age an excuse for a wide and somewhat indiscriminate lowering of the standard, which then becomes ultimately lowered generally for the whole group of children who are being trained.

Craftsmanship.—The meaning of craftsmanship is often misunderstood. There are two sides to it, the mechanical and the creative. The term " good craftsman " is often used to indicate a man who can use tools, and deal with materials accurately and with skill. It follows that a piece of work which shows these characteristics is termed a piece of good craft. It is true that this is an essential; but it is only the mechanical side. A man who can use tools and materials well is a good technician, but not necessarily a good craftsman.

The power to conceive designs for objects that will fulfil their purpose is the beginning of the job; and the power to complete well and truly all the technical processes involved in its accomplishment is the complement. Keeping this in view, we get an indication of how our work should be planned and presented to the child, and how we should ask him to approach the work he will do in the handicraft room.

The type of Child to whom Handicraft is of Greatest Value.—It is being realized that for all children practical work must take a greater part in education. A feeling has arisen that it is not so necessary for the " intellectuals " as for the " practicals ". It is a real necessity for all children. It may be that because the " intellectual " child is more readily responsive to purely academic subjects, he therefore requires more time spent on that side of the work; but that is the only reason why he should have less time allocated to him for practical work. The child who is not quite so quick in academic subjects will have more time spent on his practical work, because that is the channel through which his energies can flow more readily. When we get down to the subnormal child, we get to that stage when it is only practical work that can be used to absorb his activities, and to get any mental growth at all.

Intelligence is none the less valuable or intense because it needs practical work as its natural channel of expression. The " B " children are often leaders and organizers who, in after life, use the " A " children as helpers to pursue their business ends. The difference is one of expression, and not of quality. This statement is not one of opinion only. An investigation by the writer over fifteen schools, elementary, senior, central, and secondary, gave in all cases somewhat similar results. The " practically minded " or " B " type supplied a greater percentage of leaders than did the " A " children. This is important, for it emphasizes the contention that culture and mental power can be developed by means of practical work, and are not confined to academic education; and, further, that mental power is not exclusively synonymous with a literary education.

The Teacher

Since the introduction of handicraft, its teaching has been in the main in the hands of two types of teacher. Each type has approached the teaching of the subject from entirely different directions. Woodwork was the most widely practised of all the handicrafts in the initial stages of practical work, and, as it was undertaken for educational reasons, it was felt that its practice should be in the hands of professional teachers. These did not, however, possess the technical skill and knowledge that were required. Consequently, in the handicraft classes formed, trade craftsmen had to be called in to give them the necessary technical training. The next stage was that these craftsmen qualified themselves as well as they could to teach, and a large number of them came into the schools.

Both systems have continued with variations until the present time, and so we have with us the teacher-craftsman and the craftsman-teacher. In the first-named class, whose starting-point was the teaching profession, there has been a number whose craftsmanship never reached a high standard. Similarly, amongst the craftsman-teacher type, whose starting-point was the trade craft, there have been some whose teaching ability, knowledge of method, and personal attitude did not reach a high level, and they could not, therefore, make the fullest use of their craft knowledge and accomplishments. It is a somewhat invidious task determining which type is the more suitable, but in view of the present trend of handicraft practice it is necessary to consider the question carefully. Especially is this so when the general extension of the school leaving age is borne in mind.

In the earlier days, the employment of craftsmen as teachers of handicraft tended to predominate. This had the effect of moulding handicraft schemes and practice into a rigid and hard technical form. A reaction arose against this aspect of handicraft, the educational character of the work being emphasized. The harder and more rigid craft ideal was given up, and another demanding a less rigid accuracy was substituted. After some years of this type, it was gradually felt that good educational results came more surely through a perfect than through an imperfect form of craft. In recent years there has been a stiffening of the craft requirements, and a wider and deeper knowledge of craft processes and principles of construction is being called for. It is here that the teacher who starts from the craftsman's standpoint will be more successful.

In all crafts and professions there is what may be known as a " background of experience ", which is slowly acquired through years of practice. The craftsman has this inestimable advantage of possessing a wider and a fuller knowledge of craft than the teacher. It may be argued that the teacher possesses in fuller measure than the craftsman the " background of experience" of teaching. This is true; but some authorities think that the essentials of teaching may be acquired more readily than the essentials of craft practice. All other things being equal, the craftsman-teacher can perhaps render greater service in the teaching of craft than can the teacher-craftsman.

This greater knowledge of craft makes itself felt in a very significant way. It is a truism that children will do whatever they are shown. Their accomplishments are related to those of the teacher. If the teacher is an expert in craft either in conception or in execution, they respond accordingly. This can be noticed particularly when a change of teacher occurs. A good teacher following a poor one can get better work, almost instantly, out of the same children. A good craftsman, by sheer force of example, can often get better work done, because out of the greater and fuller background of his experience he can do better work himself. This ability to get a more perfect form of craftsmanship gives the craftsman-teacher an advantage, unless, as is sometimes the case, he is a poor disciplinarian. In view of the larger number of children of 15+ years who will be coming to us, and their greater need of advanced craftwork, this greater "background of experience" may tell still more in favour of the craftsman-teacher, and make it still more imperative that the supply, in this respect, shall not fail, but be obtainable in still greater measure.

Advice to Teacher Candidates.—For the certificated teacher who wishes to take up the teaching of handicraft, and desires the Board of Education's recognition, attendance at an approved course is necessary. Many summer schools now have their courses in woodwork and metalwork recognized as approved courses. These are one month in duration. It is necessary for the candidate to attend for two months, i.e. two years, and at the end of these to take the examination. Success in this is a qualification recognized by the Board of Education. Each course is of about 108 hours in length.

Some local authorities have similar courses recognized, and, speaking generally, the same procedure is followed. It is not, however, contended that this is all the training that is needed. The prospective handicraft teacher of this type should attend classes in woodwork, furniture making, metalwork, repoussé, and science handicraft. The technical drawing which is necessary requires a thorough grounding. A wide reading in reference to materials should be undertaken, and knowledge from as many reliable sources as possible should be obtained.

Summer courses provide besides a wide variety of subjects. All the practical work that is required to be taken in either school or centre is covered at the various summer schools, particulars of which must be sought in the advertisement columns of the educational journals. For many students these provide the only means of training.

Advantage should be taken of local training courses and schools of art, colleges of technology, and evening institutes which often offer admirable facilities for craft training.

Accommodation

The earlier rooms were originally used for other purposes, such as classrooms, parish-rooms, reading-rooms, gymnasia, and for the new purpose of handicraft fitted up with benches, tools, and other equipment. When " manual instruction " was included in the code, the call for accommodation resulted in the building of " centres ". These were built for the purpose of giving instruction in wood and metalwork to children drawn from schools in the vicinity. For many years this type dominated the instruction of children in handicraft. The subject usually taught was woodwork, with later on a lighter form of metalwork added to or worked in with it.

Much good work of the greatest value has been done through the agency of the centre system. Time has, however, shown that it possessed disadvantages, some of which are fatal to the highest fulfilment of the purpose of handicraft. It took away a batch of children from their school with a complete separation from the school influence. The work done had no connexion with the school. The instructor was a separate person almost unknown to the staff, and was, indeed, often looked upon as an outsider who was not quite of the same class as other teachers. The system was not favourable to co-operation. It helped to develop the conception of handicraft as the cinderella of the curriculum. The present tendency to transform separate centres into " practical rooms " attached to one school only will dispel these disadvantages.

Recent developments, arising out of the issue of Circular 1161 and the *Suggestions on Handwork* by the Board of Education, have created the need for another kind of practical room. In this are taken many forms of practical work such as bookbinding, basketry, raffia-work, leather-craft, &c. Sometimes these practical rooms are metamorphosed classrooms, and sometimes quite new rooms built specially for the purpose. They are in addition to the usual handicraft rooms in which wood and metalwork are carried on. The use of two rooms has arisen out of the rapid development of what may be known as " internal school handicraft ". At one time this development invaded the wood and metalwork rooms. Now it is considered that the latter should be kept entirely to this use, and the supplementary forms of handicraft carried on in separate rooms specially fitted for the purpose. This is a better arrangement, in many ways, than the use of one room for all forms of practical work.

The question whether the handicraft room should be built for 20 or for 40 children has a most important bearing upon our modern organization. During the " centre " period many of them were built for 40 and even for 60 children with a teacher for each unit of 20. This was gradually discouraged, and official opinion has rather favoured, in recent years, a centre or a room for 20 children only. As, however, our modern schools are organized on a 40 classroom basis, it would appear that the provision of a handicraft room for 40 children would be a real advantage. The whole of a form, or class, would be able to attend at one time. This avoids splitting it, and the disadvantage of having to give lessons twice to different sections of the same form.

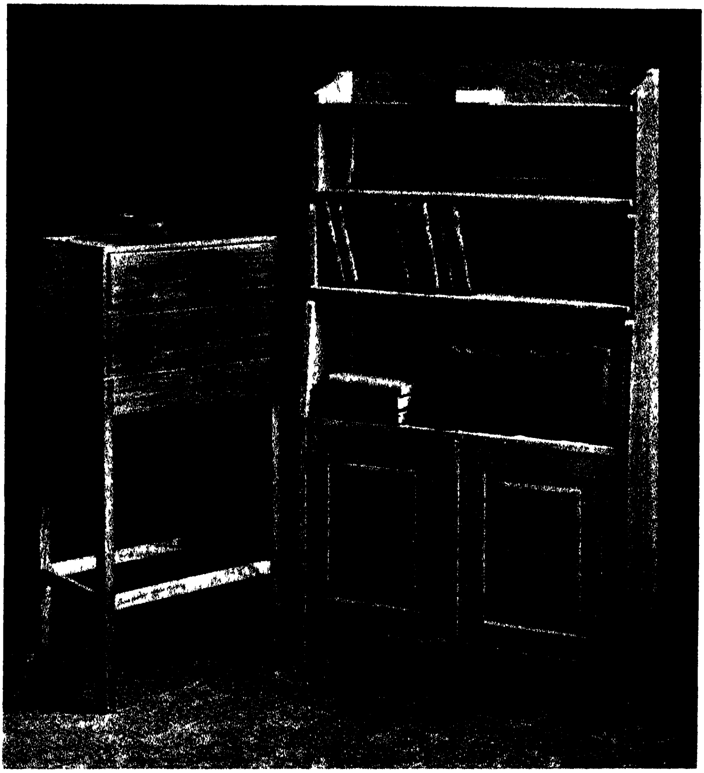
In such a specialized form of instruction it must be understood that the staffing should be upon a basis of one teacher to 20 children. In some cases the form master will be able to give the help; in others a teacher in training for handicraft; in others a newly appointed teacher seeking experience; and sometimes a fully qualified experienced teacher; but there will be a senior teacher in full charge.

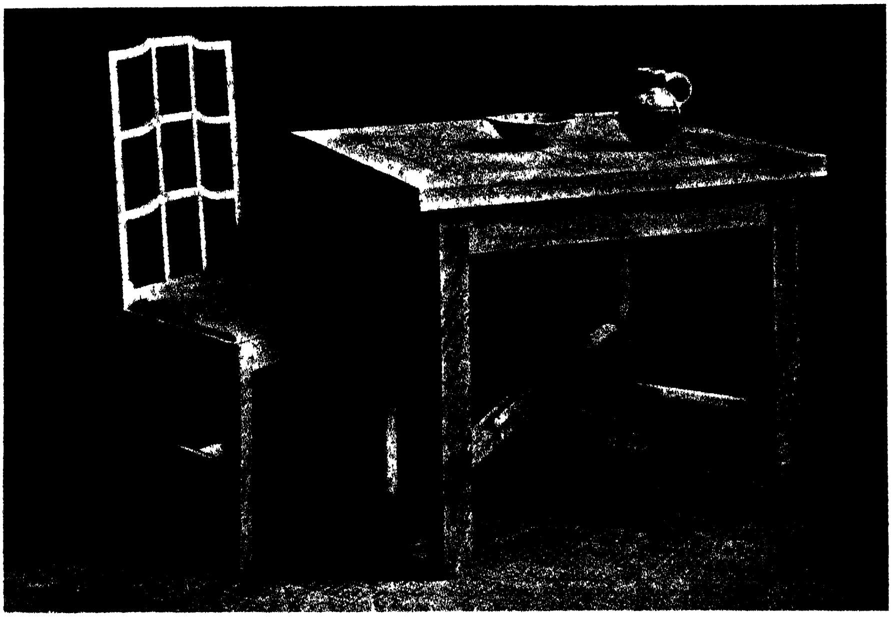
The Subjects to be Taught

Two subjects or forms of practical instruction are taken in the handicraft rooms with which we are now dealing. These are woodwork and metalwork. There are many variations. Sometimes it is woodwork only, but never metalwork only. Often a combined course of wood and metal is taught, the latter being chiefly work in sheet metal. There are rooms that are fitted with equipment for full courses in both materials for a limited number of boys. It has been a fortunate school up to the present which has had two rooms completely fitted, one for woodwork and the other for metalwork.

We are now faced with the necessity of preparing schemes for a four years' course. Many alternatives will await the decision of headmasters and teachers. Is it advisable to spend the whole of the time on woodwork? Shall we first give a two years' woodwork course, to be followed by two years' instruction in metalwork? It is possible also to consider the advisability of a four years' metalwork course. Again it is feasible to plan schemes which include instruction in both materials for the whole time. For some groups of children a light metalwork course is as much as they will manage; and there are other groups for which only light woodwork is advisable.

Much depends upon the type of school, its size and its equipment, whether rural or urban, the particular district in each, the type of child, and similar conditions. There are two conditions, however, that dominate the choice. These are: (1) the work in whatever course be chosen must be real and not academic or artificial; and (2) the child. Some children find that wood is the most satisfactory medium, whilst metal will undoubtedly appeal to others in greater degree. For some a course in which both materials are included is the best. We should make provision for all types of children, and plan our courses to suit their individual needs. If the occasion arose it should be possible for a child to take a full four years' course in either woodwork or metalwork. It has been a recognized custom for boys to have a two years' woodwork course first, followed by a one years' metalwork course, in schools where metalwork was available. Now we should be able to make the latter cover two years. There is, however, no overwhelming evidence that this arrangement is better than any other. The point to note is that we should not adopt fixed, formal, or rigid arrangements.





WOODWORK: GROUP WORK DONE BY SENIOR BOYS

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Wood is the most satisfactory material for the purposes of handicraft, and offers greater possibilities than any other. It will be, therefore, the basis of most of the work done during the four years' course. It is possible to arrange for a full four years' programme in woodwork alone. The object we have in view should be our guiding principle. It should be clearly visualized, and worked for.

The boy of 15 and over is capable of undertaking an advanced type of woodwork. Furniture-making in one form or another is likely to become the form through which handicraft will be expressed for senior boys. There is a wide field for original work in this; work that will provide more opportunities for development, both psychological and technical, similarly with metalwork. It has been the custom to commence with wood, but there is no strong reason why a full four years' course in metalwork could not be arranged if it were found that the district needs called for it, or that the boys would be better fitted for it. Looking round the whole field of woodwork and metalwork, however, wood has a wider range than metal. It would seem, therefore, that training in wood should come first (sometimes for the whole time), and metalwork would follow this, as a general rule.

When, however, we have got through a preliminary course in woodwork, and arrive at that period when boys are allowed to exercise choice in the work they do, we find that it is impossible, even if it were desirable, to restrict them to wood as the only material. The need for the use of metal invariably arises during the progress of the woodwork course. A combined wood and metalwork course is naturally called for quite early. When we begin to make real things that are part of our environment, we cannot restrict ourselves to any one material. If we adopt a metalwork course, we cannot rigidly rule out other materials.

The better arrangement would seem to be that both should be taken simultaneously. Objection may be made that the necessary time cannot be spared for this. The answer is that the modern school is to be erected on a foundation of practical work. The academic subjects are to be taken " practically ". The whole tendency is that the modern school shall be a practical school. There is time for practical subjects. As the leaving age gradually rises, as it has done in the past, and as it may tend to do in the future, we take more and more time from industry; just now we propose to take another year from it—we are proposing to eliminate the 14-year-olds from industry altogether. If this be so, surely we owe something to industry; we should use that time to increase the potential value of the child so that when he leaves school at the age of 15 he is a better trained unit than he would be otherwise. It has already been said that culture does not follow solely after academic studies, but that practical work also has its victories in this respect.

With what are known as the " B " children there should be no hesitation in providing time for both. It may be that to get the foundation of a satisfactory general training the younger children in a modern school should have more time for their academic studies. In these cases their practical work could consist of woodwork only for the first year; after that both wood and metal. As the boys proceed it will be found that some, at least, develop a preference for one particular line of work, and that they are doing their best work and gaining the greater development upon that line. This should be noted and encouraged, and arrangements made for the possibility of concentration.

Records

The correct and orderly tabulation of a boy's work is a great help in his training. It is a chart of the boy's progress, and the teacher can by this means find out instantly at what point in his work a boy may be. The methods employed for keeping these records are varied. Sometimes the teacher keeps a record of the work of each boy in each class. Sometimes each boy keeps his own record.

CHAPTER III

The Woodwork Shop

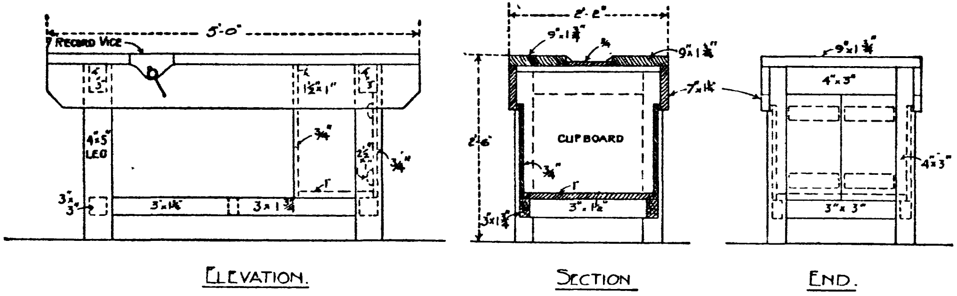
Handicraft rooms are equipped usually for twenty boys, or multiples of twenty. Reference has already been made to the apparent necessity, increasingly recognized, of having the new rooms built to accommodate forty pupils, which corresponds to the size of the forms to be allowed in the modern school. The necessity for a maximum of individual tuition determines the number of children who can be taken safely at any one time, and a greater number than twenty under one teacher is undesirable.

Accommodation and Equipment.—For each boy thirty square feet of floor area should be allowed, as well as extra space for sawing purposes, blackboards, cupboards, and other storage accommodation.

The benches are usually double, i.e. two boys work at one bench, and should be arranged to facilitate discipline (see fig. 1). At one end is a cupboard for the bench tools, and each bench is fitted with grip vices, and a tool rack. This latter fits in the cupboard when not in use. Wall benches in addition are a great convenience, for they take up less space, and give greater room for movement and for dealing with larger work. Cupboards may be fitted under them. An elevation and section of such a wall bench is shown.

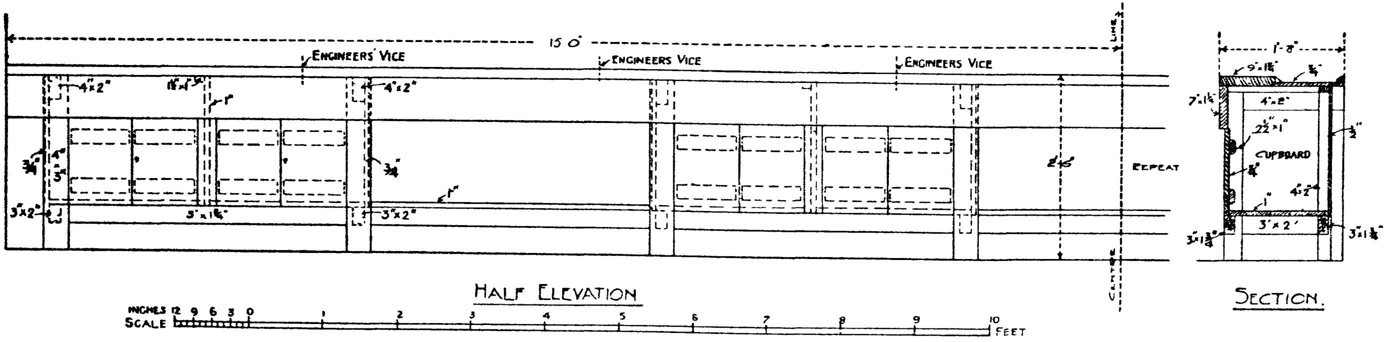
It is an advantage to have half a dozen flat-topped desks at which boys can prepare drawings. It is assumed that instruction in formal drawing will be given in the classroom, and that in the woodwork shop the entire class will not be drawing at one and the same time.

A tool cupboard for class tools is needed, and a display cupboard is advisable. It is a usual practice to let children take their work home.



No. 10 Dual Benches

Benches to be constructed in red deal. Each to be fitted with No. 2 7-inch "Record" instantaneous grip vices and No. 2 hardwood stops. Each cupboard to be fitted with No. 1 brass bolt and No. 1 approved spring catch on face of doors.



No. 1 Wall Bench, 30 feet long

Benches to be constructed in red deal. To be fitted with No. 8 engineers' parallel vices, 3½-inch jaws. This bench to have No. 8 cupboards, each fitted with No. 1 brass bolt and No. 1 approved brass lock.

Fig. 1.—Lubbesthorpe Senior Council School—Details of Woodwork Benches

The wise teacher, however, always has adequate examples of such work to show his aims and methods, and also to inspire the boys.

The storage of drawings, and of work in process of making, is often a source of worry. A practice that has been found of great value in the storage of unfinished work is to have one locker for each form, or class, or group. Locking up ensures safety.

There is every reason why boys should build up whatever equipment and apparatus they can. The construction of saw boards, shooting boards, various racks, cupboards, shelving, and book-shelves, may well form part of their training.

Tools.—The bench tools consist of the jack plane, chisels, try square hammer, steel rule, tenon saw, and marking gauge. These are better accommodated in a rack which can be taken easily from the cupboard and replaced when done with. With respect to the rest of the tools, such as hand saws, mallets, extra chisels, braces and bits, bradawls, screwdrivers, pincers, mortise gauges, spokeshaves, and bow saws, it is a good practice to house these on racks on the wall, so that they are always in sight. Any omission can be detected at once. If, however, the rooms for woodwork are used for other purposes also, it is well to fit up a tool cupboard to take all the tools other than bench tools.

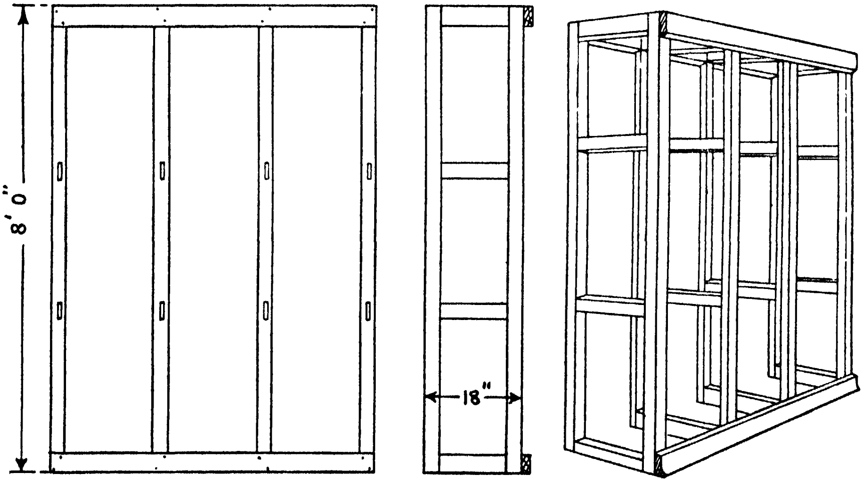


Fig. 2.—Upright Timber Rack—Front Elevation, Side Elevation, and Sketch

A rack to accommodate drawing boards is needed, and T-squares should be hung on rods or nails fixed in the wall.

Timber.—For this there should be a store-room which can be locked up, and which will take the bulk of the timber. A small amount can be taken out for each day's use, and kept in the handicraft room.

Methods of storing timber vary; the method shown in fig. 2 is one that has been tried and found to be suitable. In this arrangement the timber stands on end. It is cut to lengths of eight feet, and in each bay stands timber of similar thickness or kind. It is easier to get at each piece in this way than when timber is laid flat. Timber, however, that is drying is much better stored horizontally. Shelves or racks for the storage of short ends are necessary.

Glue, Stain, Paint, and Varnish, &c.—Stain, paint, varnish, and oil are better accommodated in a smaller cupboard, or set of shelves or nest of pigeon holes. Each pigeon hole should be labelled. The work of painting, staining, and varnishing is better done if carried on in a separate room, or in a portion of the room spaced off separately. This confines the splashing to one place; and it keeps the work clearer of dust.

The cupboard is usually fitted up for the storage of nails, screws, and similar oddments by means of additional narrow shelves.

The glue is heated in a glue kettle which needs an oil stove, gas ring, or electric heater. A specially devised glue heater to accommodate three kettles is supplied by Fletcher-Russells of Warrington.

Grindstone and Oilstones.—A special place for the sharpening of tools is needed. This should be where boys who are doing this work would not be in the way. A grindstone for hand and/or foot power is usually provided. It is often fitted with a special apparatus for holding plane irons, so that boys can hold these correctly in position. It is better if the grindstone is placed on a metal tray to catch the dripping water.

The oilstones should be at least two in number, viz. an India stone for quick reduction of the steel, and a Washita stone for gaining a smooth cutting edge. These should always be on a special shelf or bench. Washita slips with rounded edge should be provided for the sharpening of gauges, and an Arkansas or India slip for carving tools. The oil used is preferably greasing oil. The oilstones should be cleaned after use; otherwise the oil sinks into the stone and hardens it. A piece of cotton waste is required for this purpose, as well as to wipe the oil from the plane irons.

Machinery.—It is a somewhat disputed question whether we should install power machinery in a woodwork shop, and, if so, how far we should go in such equipment. Whatever may have been the practice in past times, it is certainly desirable, in view of the extension of the school age in modern schools, that the older children should be brought into touch with some labour-saving machines. So long as the work has been looked upon as purely educational, hand practice may be accepted as desirable. When, however, we adopt methods with a more pronounced bias in favour of vocational and utilitarian practice, we must see that contact is made with the methods that prevail in modern power workshops.

It is not possible to go very far perhaps. The following tools may be looked upon as a limit: (1) a circular saw with a rising and falling table (or spindle); (2) a band saw; (3) a lathe; and (4) a " facing and thicknessing " machine.

These are labour-saving machines which may be quite legitimately installed. Anything in the way of finishing tools, such as glass papering machines, should be deprecated. All finishing should be by hand.

If it is not possible to have power, the tools that may be installed are: (1) a hand circular saw, with a rising and falling table (or spindle); (2) a foot treadle lathe; and (3) a treadle fret saw. These would save a good deal of labour.

For the machines mentioned above, fencing is necessary. Suitable fences and guards are generally supplied with the machines; but belts also may require guards.

If considered necessary, the grindstone can be linked up with the power. This may mean more countershafting, but countershafting will probably be required in any case so that there will be no difficulty.

Needless to say, if machinery is introduced, more floor space will be needed. Indeed, it is better to have the machinery in a separate machine-room, or at any rate well screened off from the rest of the room. Plenty of light should be available.

Lighting, &c.—The lighting arrangements govern the planning of the benches also. Light should come from the sides of the room and the light then streams along the bench. For artificial light, one light should, if possible, be placed over each bench.

A clear run-way for the timber is needed, for although, in general, the wood used will be in small pieces, yet, occasionally, large pieces will be dealt with; for example, goal posts and net-ball posts.

A sink and water supply are advisable and convenient, if not necessary, in any handicraft room. In any case the water supply should be close at hand.

A wall blackboard (or boards) is a great help. The advantage of more than one board is that sketches can be made on the smaller boards, sometimes for the benefit of groups and sometimes for individuals.

A reference library is necessary to any handicraft room. Books and portfolios which contain examples of good work of all kinds are needed. Books containing descriptions of tool operations and constructional processes, knowledge of materials, and of processes of manufacture, should be included.

Combined Room for Woodwork and Light Metalwork.—The general equipment for such a room will be the same as for woodwork, with additional provision for light metalwork. Work can then be carried on in tinplate, sheet brass, copper, aluminium and pewter, in sheet iron, and in small-size iron bar and rod. The metalwork will be subsidiary in character to the woodwork scheme, and to a large extent will arise out of it.

If the room is fitted with side or wall benches, some of these will have 3-in. metalworkers' parallel vices; half a dozen will probably be sufficient. There should be a large flat table, say about 5 ft. by 4 ft., for sheet metal working. A rack for tinplate, copper and brass sheet, and short ends and cuttings, is needed (see fig. 3); the upper part for sheets and rolls of metal, and the lower part for the cuttings. Iron rod will be accommodated on a shelf having a ledge at the front, and coils of wire will hang on hooks fixed into the wall. Racks for files, tongs, shears, mallets, hammers, and other tools are required, and most of these could be made by the boys as part of their scheme. A block of wood bored to hold drills, wooden boxes fitted up for small tools, a block of elm or similar hard wood for stakes, and for beating sheet metal into curves, are other requisites.

A soldering stove and a small brazing hearth are wanted, and for these a separate bench is preferable. A few pitch blocks should form part of the equipment; and a bick iron, hatchet, and similar stakes will be accommodated in the elm block when in use; when not in use they should be stored in a suitable rack. The elm block should be about 30 in. to 36 in. high and 12 in. to 18 in. in diameter. A large (5-in.) parallel vice is useful, for sometimes the stakes render better service if they can be fixed in a bench vice. See p. 172 for the full equipment. A cupboard kept entirely for metalwork tools, papers, and unfinished work is a real asset.

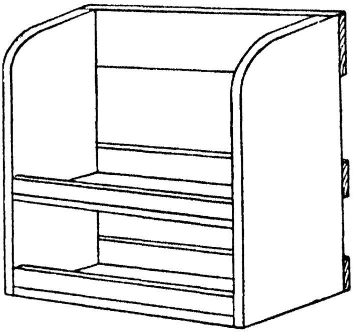


Fig. 3.—Rack for Metal

Unlike the requirements of a full metalwork course, when each boy has a set of bench tools which are kept in a rack or drawer near his place, for a partial metalwork course twenty full sets are unnecessary, and it is better to keep the few tools in a box or drawer. The intention of a partial metalwork course is to supplement the woodwork course, by making hinges, handles, umbrella stand trays, and similar fitments.

CHAPTER IV

The Metalwork Room

It is rarely that children begin their training in handicraft with metalwork, but for large schools, and older children, the provision and equipment of a room used exclusively for metalwork is indispensable.

Accommodation and Equipment.—For the accommodation of twenty boys, the following general remarks and advice apply. Each boy should have a separate working place, with his own personal tools, such as a hammer, steel rule, scriber, calipers, steel compass, files, centre punch, cold chisel, and similar tools. He is thus in no need to leave his own bench. This will be fitted with a 3-in. or 3½-in. metal parallel vice. These benches can be wall benches, or separate single benches. A good natural light should fall on each bench. Then a large bench with a clear flat top is necessary for sheet metalwork. Another bench is needed for the soldering operations. This should be iron bound, or fitted with asbestos sheets. Tool racks for the general class tools are needed. These should be visible in order that shortages can be seen quite easily, and so placed that the tools are within easy reach.

At least one forge is needed. These are either built into the room or they can be portable. The latter type is quite practicable and workable. It takes up less room than the usual built-in forge, and can be placed where desired. The cowl to take away the smoke is best fitted so that the pipe can be carried into an existing flue; if this is not possible, it will be taken outside, and fitted with a special smoke cowl. The floor around the forge and anvils (one anvil may be enough) should be made fireproof by concrete or by some of the patent fireproof materials.

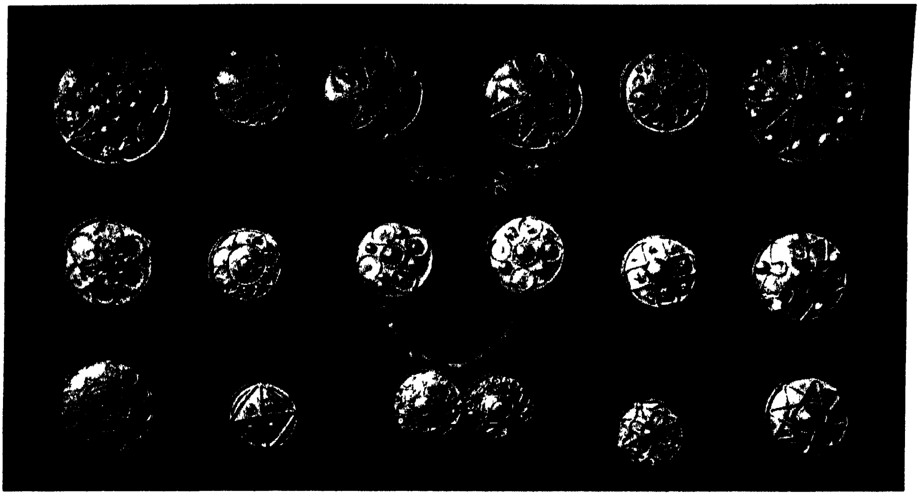
A water-trough is necessary, with sledge hammer and, say, five forge hammers. For cutting metal, the anvil will be fitted with hot and cold sets, and for shaping it a swage block and fullers are wanted; tongs of various kinds are needed, and a wrench for twisting hot metal. A rack on the wall should be provided to hold the smaller hammers, fullers, tongs, and similar hand tools. The swage block may rest on the floor, but like the anvil it is better if raised.

Accommodation for fuel is wanted. Small coke breeze, which is coke broken up finely, is the fuel used. A sheet-iron coke box can be made for this purpose.

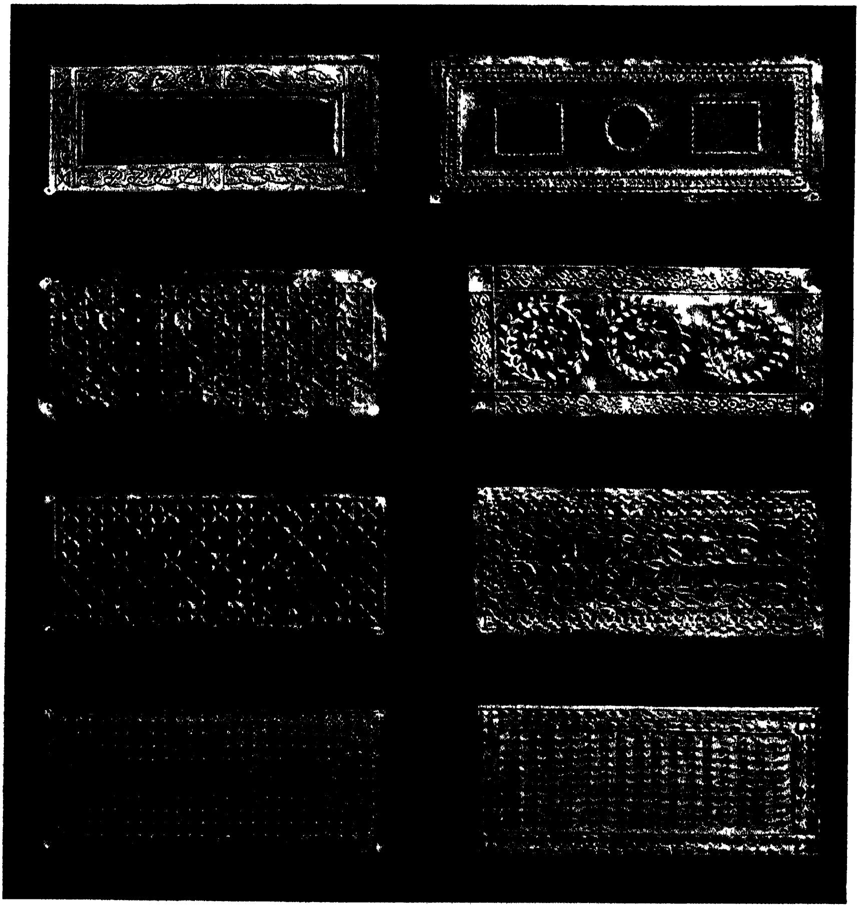
Lathes are needed, and a good deal of care is required in making a selection. Although the lathe is a tool that is used very largely in industry, and is indispensable in the making of so many articles, yet its value as training is not so great as that of a forge. At the anvil the work has to be done whilst the iron is hot, by hand; the shaping can only be done in that short interval of time that it remains at a suitable temperature. Judgment in shaping and quickness in operating are essentials.

With a lathe, the training consists largely in setting the machine so that it will do the work. After that the operation is largely mechanical, unless hand turning tools are used; in the latter case the training is satisfactory. At the same time industry uses lathes to an increasing extent, and this justifies the use of lathes in a school metalwork shop. Whether or not power is available, a lathe fitted for hand turning is necessary. A Drummond screw-cutting lathe does satisfactory work. This should have a three-jaw chuck. Much depends upon the schemes of work adopted, whether other lathes will be used. If a good deal of turning is incorporated in the scheme then a second is certainly needed. This should also be a screw-cutting lathe capable of taking larger work of a heavier type than the Drummond., The lathes should be placed so that both natural and artificial light is readily available.

A grinder will be fixed to one of the benches. This is needed for tool-



Exercises in simple raising, wire drawing and twisting, the making of grains and pellets, and soldering Original designs for buttons, clasps, and brooches prompted by these



By courtesy of the Director, Central School of Arts and Crafts, Birmingham

These. and other exercises shown here illustrate the fertility of invention which may be evoked

grinding. A polishing and grinding head should form part of the equipment, for finishing purposes. A hand lever shearing machine is indispensable for cutting metal that cannot be cut with the hand shears.

There should be two drilling machines, one for light work, the other for heavy work. The latter should drill holes up to ½ in., and the former to ¼ in. These will be fixed to benches, where there is a good light, and where boys can work without crowding.

A brazing hearth for hard soldering may be accommodated on the soldering bench, and fitted with blowpipe and bellows. Alternatively, a portable brazer fitted with blowpipe and bellows, and connected with the gas supply, should be provided. This will stand on the concrete floor.

A chipping block should be on the large table, and a surface plate to test level surfaces is desirable.

A variety of stakes is required. These should include the bick iron, the hatchet stake, half-moon stake, creasing stake, funnel stake, anvil stake, and a tinman's stake. For the latter several kinds of head will be needed for different shaping jobs. These stakes can be fitted into an elm block, as already mentioned, but if there is room, an arrangement as indicated in fig. 5 will be found of value. This can be made by the boys in the woodwork room.

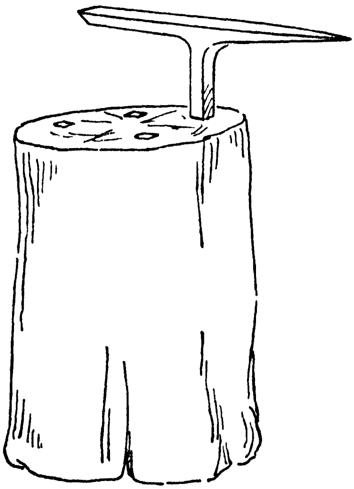


Fig. 4.—Stake Block

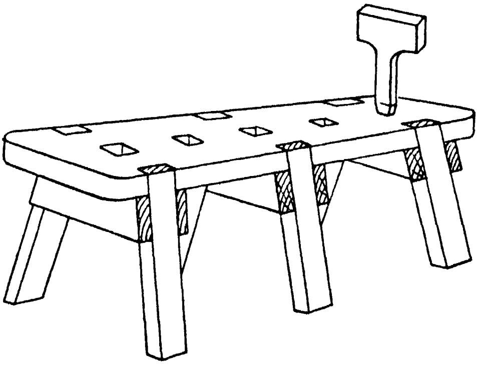


Fig. 5.—Stake Bench

Storage of Materials.—A small separate storeroom is desirable for the metal stock. The iron bar and rod will be accommodated on a rack to take 12 ft. in length, fixed to the long wall. The sheet metal of all kinds can be kept below this rack, leaning against wood grounds fixed to the wall. In the metalwork room, metal for immediate use can be kept in a suitably fitted corner; the bar and rod iron can be stood on end, and the sheet metal in the rack already mentioned (see p. 167).

Storage of Unfinished Work and Drawings.—The cupboards under the wall benches will take these. Each cupboard will be fitted to take the work of each form, and the doors should be kept locked. The lockers mentioned as suitable for the woodwork room may be used for the storage of metalwork also.

Power.—Reference has already been made to the fact that there is some disagreement as to the advisability of installing power (see p. 165). If power is installed, however, it is better to have the motor outside the metalwork room, and under cover. The power will be transmitted to the machines by countershafting. This is better if fixed overhead; and, incidentally, the roof structures should be examined, as they may need strengthening to carry the necessary weight. The machines should be placed so that they run the same way as the countershafting. As with the machinery in the woodwork shop, the belting and the exposed parts of the machine must be well protected with wood and metal guards.

CHAPTER V

Detailed Equipment

Woodwork Room.—It may be accepted that a maximum of efficiency at a minimum expenditure should be the general aim. The woodcarver, for example, who has the greatest number of carving tools is not necessarily highly efficient in his craft. Skill is often developed and resource is stimulated by the possession of only a small equipment. We append a specification for the economical equipment of a handicraft room for twenty boys, to be used entirely for woodwork. Some of the articles in the equipment can be made by the boys as part of their work (see p. 164).

Object.	*Number.*
Double benches with instantaneous grip vices, and cupboard at one end	10
Bench brushes	5
Store cupboard	1
Show cupboard	1
Lockers (one for each class) ..	10
Blackboard on wall	1
Blackboard dusters	3
Blackboard T and set squares and compass	1 set
Teacher's desk, chair, and bell	1 each
Waste-paper basket	1
Grindstone	1
Jack planes (small pattern)	20
Tenon saws, 10″ (for constant use)	10
10″ (for reserve)	3
Hand saws, 22″ panel (8 teeth to inch)	2
24″ rip (5 teeth to inch)	2
Hammers, ¾ lb. (Warrington) ..	10
Mallets	10
Gauges (single marking)	20
(mortise)	4

Object.	*Number.*
Try squares, 4½″	20
12″	2
Smoothing planes, 2″ iron	5
Square plane, 1″ iron	1
Firmer chisels: ¼″, ½″, ¾″ (each size)	20
⅛″, ⅜″, ⅝″, 1″ (each size)	5
Mortise chisels; ¼″, ⅜″ (each size) ..	4
Gouges (firmer): ¼″, ½″, ¾″ (each size)	2
(scribing): ¼″, ½″, ¾″ (each size) ..	2
Braces	2
Braces, ratchet	1
Bits: centre, ¼″ to 1½″ (in all) ..	20
shell, 3/16″, ¼″ (each size)	2
twist, ¼″, ⅜″, ½″, ⅝″ (each size) ..	1
countersinks for wood and brass (each)	2
Screwdrivers, 8″ to 5″ (each size) ..	3
Pincers	2
Nail punches	6
Spokeshaves, 2″ blade, 2½″ blade (each size)	3
Bevels	4

Object.	*Number.*
Bow saws: 9″, 10″, 12″ blades (each)	2
12″ steel rules, 1/16 one edge, millimetre the other	20
Marking knives	20
Glue pots (Fletcher-Russell's fitment for 3)	1
Bradawls (assorted) in use	6
blades (in store)	24
Compasses (steel wing)	5
Oilstones: India (for quick cutting)	1
Washita	1
slips, various	2
Oilcans	1
Cramps, 3′ pair	1
Plough, wood, with set of bits ..	1
Files in handles: 10″ H.R. and flat —bastard (each)	3
Cork rubbers (each)	5

Object.	*Number.*
Scrapers, straight and curved (each)	2
Shooting boards (small pattern) ..	10
Saw boards (bench hooks)	20

DRAWING.

¼ imperial drawing boards and T squares	20
½ imperial drawing boards and T squares	2
Set squares 45°, 30° (each)	24
Pencil compasses	24
12″ boxwood rules	24

A rack for the drawing boards and T squares; another for the set squares; a box for pencils, compasses, and rulers may be made by the boys.

Material.—The specifications and costs of this vary with local circumstances. Red deal is now used very largely, and may be looked upon as the stock timber, with smaller quantities of canary wood, satin walnut, oak, and mahogany. Sycamore and beech are used in smaller quantities for special purposes. Although the cost varies in different districts, it may be assumed that an annual expenditure of 3*s*. per head should cover the cost of all consumable materials for a handicraft room training 200 children. The orders can be based on the following sizes and particulars.

TIMBER

Red deal in boards: 1″, ¾″, ½″, and ⅜″ ordered by the square foot.

This can be asked for in widths varying from 6″ to 9″. Occasionally wide boards are required, but a rather steep jump in price occurs between widths of 9″ and 11″. Although the boards can be had machine planed, yet it is better, speaking generally, that boards should be obtained in the rough.

Red deal in scantlings: 1½″ × 1½″, 2″ × 2″, 3″ × 2″ are useful sections. These are ordered by the lineal foot.

Tile laths (about 1¼″ × ⅞″) are useful and come in bundles. They are good for preliminary work and for small door-frames, clothes-horses, frames, and similar articles.

Plywood is a useful material for many purposes. It has come to stay, and so long as judgment and discretion are observed in its use it is a legitimate material.

It can be obtained in various thicknesses; 4-millimetre and 6-millimetre thicknesses are the most generally useful for the woodwork room. It is ordered by the sheet and they run to about 17 sq. ft. each.

DRAWING.—⅛ and ¼ imperial cartridge paper. Drawing pins. Drawing pencils, H.B. and H. Rubbers.

HARDWARE AND SUNDRIES.—No quantities are given, but particulars of sizes are indicated for ordering.

Nails, oval wire: ¾″, 1″, 1¼″, 1½″, 2″, 2½″.
round wire: 1½″, 2″, 2½″ 3″.
Screws in gross packets from 1¼″ × 1 to 2½″ × 12.
(The numbers indicate the thicknesses of the screw.) They are obtainable in steel, brass, and copper, and have heads that are countersunk or roundhead.
Glue is obtainable in cakes, and is sold by the pound. Glue brushes, small and large.

Panel pins: ½", ¾", 1", 1¼".
Glass paper Nos. 0, 1, 1½, 2, 2½ in quires.
Oil for oilstones, lard oil or greasing oil.
for tools, raw linseed oil.
Emery cloth, fine and medium in quires.
Cotton waste, for cleaning tools and oilstones, per lb.

Combined Woodwork and Light Metalwork.

For a combined course of light metalwork and ordinary woodwork the following equipment would be necessary in addition to that detailed on the preceding pages:

Object.	*Number.*
Wall bench with parallel vices	1
Soldering bench with stove, the bench top-lined with asbestos or sheet iron	1
Large flat bench for sheet-metal work	1
Store cupboard for metal work	1
Bick iron	1
Mushroom stakes, two sizes (each)	1
Shears, straight 2½" blade	3
curved 2½" blade	3
large Scotch	1
Files. Assorted: half-round, flat, 3 square, 4 square, rat-tail, 4" to 10"	24
Hammers, engineers' ballpane: ½ lb., ¾ lb., 1 lb. (each)	2
collet	1

Object.	*Number.*
Hammer, tray blocking	1
planishing	1
Bossing mallet	3
Flat-head mallet	3
Blowpipe (for mouth)	1
Screw plate	1
Pickle jar or bowl	2
Hack saw, adjustable frame	1
Centre punch	3
Hand drill and 12 twist drills, assorted sizes (set)	1
Cold chisels: ½", ⅝", ¾" each	1
Pliers: round nose	3
square nose	3
Ladle (for lead)	1
Copper bits: ½ lb. to 1 lb.	3
Tongs, flat-mouth	1 pair

Wooden blocks and mandrels may be made by the boys, and iron and steel stakes also may be made from short ends of steel of various sections. Repoussé tools can be made by the boys also from tool steel $\frac{3}{16}$" square section.

Metalwork Room

Object.	*Number.*
Separate benches (or places)	20
Soldering and brazing bench	1
Portable forge	1
Brazing hearth with blowpipe	1
Water trough	1
Anvils (100 lb.) and stands	2
Sledge hammer, 4 to 7 lb.	1
Forge hammers, 1 lb. and 2 lb. (each)	2
Hot set, cold set, hardie (each)	1
Fullers (pair)	1
Flatters (pair)	1
Swage block, 102 lb.	1
Tongs: hollow bit, open mouth, close mouth (pairs each)	2
Rodded punches: square and round (each)	1
Bick iron	1
Hatchet stake	1
Half-moon stake	1
Creasing stake	1
Bottom stake	1
Funnel stake	1

Object.	*Number.*
Drilling machine (bench) to take ⅜" drills	1
Emery grinder	1
Shearing machine to cut $\frac{1}{16}$"	1
Lathe: 4" screw cutting	1
small bench pattern	1
3-jaw chuck to fit lathes	2
Engineers' hammers, ¾ lb. (each)	10
½ lb. (each)	5
Chipping block	1
Solder bits (hatchet and square)	6
Blowpipe, for mouth (each boy)	1
Calipers: 4" outside (pairs)	5
4" inside (pairs)	5
Pliers: round nose (pairs)	3
square nose (pairs)	3
sleeve nose (pairs)	3
wire-cutting (pairs)	3
Twist drills: assorted, $\frac{1}{16}$" to ⅜"	24
Shears: large Scotch	1
Tinman's snips: 2½" blade, straight	3
2½" curved	3

Object.	*Number.*
Spanners: set double-ended, ¼″ to 1⅛″	1
Adjustable spanner	1
Oilcans	5
Wire gauge	1
Scribing block	1
Surface plate	1
Scribers	10
Hide mallets	10
Tray blocking hammers	2
Planishing hammers	2
Collet hammers	2
V-blocks (pair)	1
Stocks and dies: straight pattern, ¼″ to ⅝″ taper and plug taps (set)	1
Tap wrench, 7″	1
B.A. stocks and dies and tap (set)	1
Screwdrivers (assorted)	6
Hack saws	6
Spring dividers	6
Steel rule: 3 ft. long	1

Object.	*Number.*
Lathe turning tools (set)	2
Letter punches (set)	1
Number punches (set)	1
Files, various: 4″ to 10″, smooth, bastard, and 2nd cut (dozen)	4
Steel compasses	3
Polishing, grinding, and buffing heads (set)	1
Cold chisels: ¼″ to 1″	6
Centre punches	3
Lathe carriers	6
Centre squares	2
Hornbeam bossing mallets	3
Flat mallets	3
Creasing hammer	1
Rivet sets: ⅛″, 1/16″ (each)	1
Piercing saw frame and blades	1

DRAWING.—The same equipment as for woodwork. Some instructors prefer a hard pencil for metal work.

MATERIAL

Tin plate.—The usual thicknesses used are one cross (s.g. 28), two cross (s.g. 27). A convenient size of sheet is 14″ × 20″.

Copper and brass sheet.—These are usually 4′ × 2′ in area; and the usual thicknesses for the metal workroom are s.g. 23 and s.g. 20.

Copper and brass rod.—Round from ⅛″ to 1″ diameter; square from ¼″ to 1″ side; rectangular from 1/16″ × ½″ to 1″, and ⅛″ × ½″ to 1½″.

Copper and brass wire.—This can be obtained in any size of wire gauge. Gauges 12 and 16 are the most convenient, but finer is used for ornamental purposes.

Wrought iron and mild steel.—Steel metal is usually in sheets 6′ × 3′. It can be obtained in all standard gauges.

Rod iron can be obtained as follows: Round ⅛″ to 3″ diameter; square ⅛″ to 3″ side; rectangular, 1/16″ × ¼″ to 4″, 3/32″ × ¼″ to 2″, ⅛″ × ¼″ to 6″, 3/16″ × ¼″ to 4″, ¼″ × ⅜″ to 6″, 5/16″ × ½″ to 1½″, ⅜″ × ½″ to 1½″, 7/16″ × ½″ to 1½″, ½″ × ¾″ to 2″.

Cast steel.—For use in tool-making, can be obtained as follows: round, ⅛″ to 1″; square, ¼″ to 1″; hexagonal (measuring across flats) ⅛″ to 1″; octagonal (measuring across flats) ¼″ to 1″; rectangular, 1/16″ × ½″ to 1″, ⅛″ × ½″ to 2″, ¼″ × ½″ to 1″.

Zinc.—Sheets are in sizes of about 8′ × 3′ and in all sizes of the zinc gauge. It can be obtained from stock in round section, ¼″ to 1″.

Aluminium.—Sheets are 4′ × 2′ and 6′ × 4′ in all standard sheet gauges, and in round section 1/16″ to 1″.

Wire.—In iron, steel, tinned, coppered, copper, brass, and aluminium in all wire gauges.

For weights it is useful to know that 1 sq. ft. of copper of standard sheet, gauge No. 24, weighs 1 lb.

SOFT SOLDER.—Obtainable in sticks per lb.

SILVER SOLDER.—In small sheets of various thickness and constitution.

RIVETS.—Snap head, conical, pan and countersunk heads, in brass, copper, aluminium, wrought iron, and mild steel.

They are sold by weight, and specified by thickness in fractions of an inch.

FLUX.—This can be one of the prepared solutions such as Baker's fluid or Fluxite; or it may be killed spirits, tallow, resin, or whatever is suitable for the job. Borax is used for silver soldering and welding wrought iron.

CLEANING AND COLOURING MATERIAL.—Dilute 10 per cent sulphuric acid cleans brass and copper, and ammonium hydro-sulphide colours them brown to black (the latter for copper), and pumice powder will polish them up as far as is required. Beeswax and turpentine will put a coat on that can be polished dull. Emery cloth and linseed oil is needed to polish iron and steel.

CHAPTER VI

Contents of Course

In times now gone, a full three years' course was planned, in which every " model " in a course was specified in respect of its general purpose, its shape, and its sizes in every particular. Nothing was left for the child to do but to follow each one of the details given to him. Craftsmanship was understood to mean the accurate and skilful use of tools and materials. The boy was drilled in the use of tools. He was being trained as a technician before the time was ripe, and any creative power he possessed was ignored, and even suppressed. Emphasis was laid on the mechanical side of the work, and the importance of inner growth, which is the result of creative effort, was neither appreciated nor understood. A reaction naturally arose against this attitude, and for some time the practice of handicraft was influenced by a school of thought which proceeded to the other extreme. Children were allowed, encouraged, and sometimes directed to do what they liked. Creative power was to be expressed to its fullest extent; but how could this be when the form was not prepared for it? Past experience was to be ignored. Children should not be taught; they should, on the contrary, find out everything by their own experience. A chisel cuts wood and flesh alike; the child must find out for himself how to hold a chisel so that it cuts wood and not flesh. A table is being made; the method of fixing the legs, rails, and top has to be left to the boy to " find out "; the contention being that he will, therefore, extend his knowledge and, more important still, will develop his powers of invention and resource much more thoroughly than otherwise would be the case. Since then, it has been the general opinion that one method cannot do without the other; that, in fact, the two must be considered jointly. Both are aspects of one problem. Neither must be given an exaggerated importance that will disturb the whole. In the preparation of schemes opportunity must be provided for full expression of the creative, and, at the same time, the teaching of right craft methods.

General Outline

PRESCRIBED WORK. — In the scheme prescribed work is generally provided for by arranging a short introductory course of objects that incorporate technical processes, and tool operations, leading to tool practice and the manipulation of materials. Then later the course of work will be partly of the boy's own suggestion, and partly prescribed work. In the latter, definite sizes and shapes are given, to which adherence must be made. This work can be used at the discretion of the teacher to suit the needs of each child. Some boys are naturally such good craftsmen that it is not necessary to give them much formal work after the first introductory course.

Suggestions for the preliminary course are given on p. 177.

Free Work.—There are three possible sources from which children may take their work.

The child's own needs.—A child's interests consist largely of games and toys. Even the older children will be absorbed in the making of a simple toy, a working model, or the apparatus for a round game. In the making of a marble board, or a moving toy, or a simple steam-engine, or an electric candle, the boy relates the facts of life to his own activities. There is an advantage in making such objects. The "electric candle" must provide light; therefore, all its connexions must be made good enough to be permanent. The marble board must allow of a game of marbles being played with it, e.g. the holes must be large enough to allow a marble to pass through, but not with too much margin; the steam-engine and the moving toy must work. All this means that the craft standard, so far as construction is concerned, must be satisfactory.

The needs of the home.—Children early come to a realization of the needs arising out of their contact with environment. The home surroundings provide a very fertile field for objects that can be made in the handicraft room. In these can be included all the training that a boy needs in the way of tool operations, and the manipulation of materials. Each room in the house can be taken and each can contribute to a course of work, many articles which fall within a normal boy's capacity. Here again is a real incentive to good work. It is probable that parents will pay for materials in such cases, and the boy will certainly feel that he cannot waste the money spent, to say nothing of the indignity of making something which, because it is badly made or planned, does not fit its purpose.

Included in the "home interest" group will be the garden—line winders spade scrapers, seed guards, seed drills, potato boxes, fruit-gathering boxes, fences, gates, garden huts, cold frames, and even a small greenhouse. Many of these objects provide for co-operative work.

Here in this second group we get a wider appeal—the appeal to that section of the community contained in the boy's home. It is still selfish in its essence, but is not so intimately concerned with his personal needs; he has got to the stage when the needs of others become evident. The moral value of this is great, and by having, in some cases, to work with other boys on the same job, he learns to subordinate his activities to theirs, and to work in harmony with others—another important advance.

The school interest.—(i) Craft work. This is a stage still farther in advance. The two previous groups are concerned with work that arises out of the needs of the self, and the small group to which it belongs. School needs are wider and more impersonal. Experience shows that a large number of boys really do enjoy making apparatus for the school. This is satisfactory from a social point of view, and also because the school needs can provide such a wide variety of suitable handicraft. Much teaching apparatus can be included purely as craft. Games call for jumping stands, apparatus for net ball, stool ball, football, rounders, cricket; internal needs call for shelving, cupboards, racks, and tools. The handicraft room itself can provide much work for the purpose; the fitting up of tool racks, shelves, lockers, and the making of saw boards, shooting boards, saw stools, cupboards, book racks, and similar objects are all legitimate units to include in a scheme.

(ii) Illustrative work. Included in the "school interest" is the large body of work that is concerned with the teaching of school subjects. The work referred to so far is concerned with craft values, and with the making of objects of personal or group utility, and the production of real things for the real purposes of life. With illustrative work the objective is entirely different. Much woodwork and metalwork can be used for the illustration of, for example, history, geography, and science. It is not, however, such a simple or as straightforward a matter as the craftwork with which we have been so far concerned and needs very careful planning and organization.

Let us assume that we wish to illustrate a course of magnetism and electricity. The day is past when physics was taken purely theoretically. To talk about electric bells, and not make one, is to miss a useful contact with reality. In such a course it may not be possible for each child to make each instrument and piece of apparatus, but it is possible for the necessary practical work to be spread over the whole class, so that the instruments necessary to the wide practical illustration of the syllabus may be made. The association of practical work with theoretical knowledge invests the subject with a greater interest, confirms mental images, and makes more permanent the memory work involved. We do not readily forget what we have once done with our hands.

One of the greatest difficulties we encounter when we wish to illustrate school subjects is that of synchronization. The principle underlying the working of an electric bell can be memorized in a very short time, but the making of the bell covers a much longer period. Then again, if each boy has to illustrate all the principles he learns in the science course, the complete work of illustration becomes impossible. Yet practical work is a real advantage. The boy ends by knowing more, and that more thoroughly, and he has his range of usefulness extended by his ability to make scientific apparatus. How shall we get over the difficulty? The following method was adopted in one school with success.

The science syllabus was considered at the beginning of the course, and note was made of whatever apparatus was required. The work was spread over the whole class; the smaller apparatus was made by individual boys, and the larger pieces by groups. During the first few months all the illustrative apparatus and instruments had been made, and were used when needed. They were not made at exactly the same time that the theoretical work was being done, but before, and they were quite ready when the lessons had to be taken. (See plate facing p. 4.)

The consideration of this aspect of illustrative work gives rise to various questions. What, for example, is the function of the handicraft room, and the handicraft teacher, in respect of illustrative work? Shall the latter collaborate

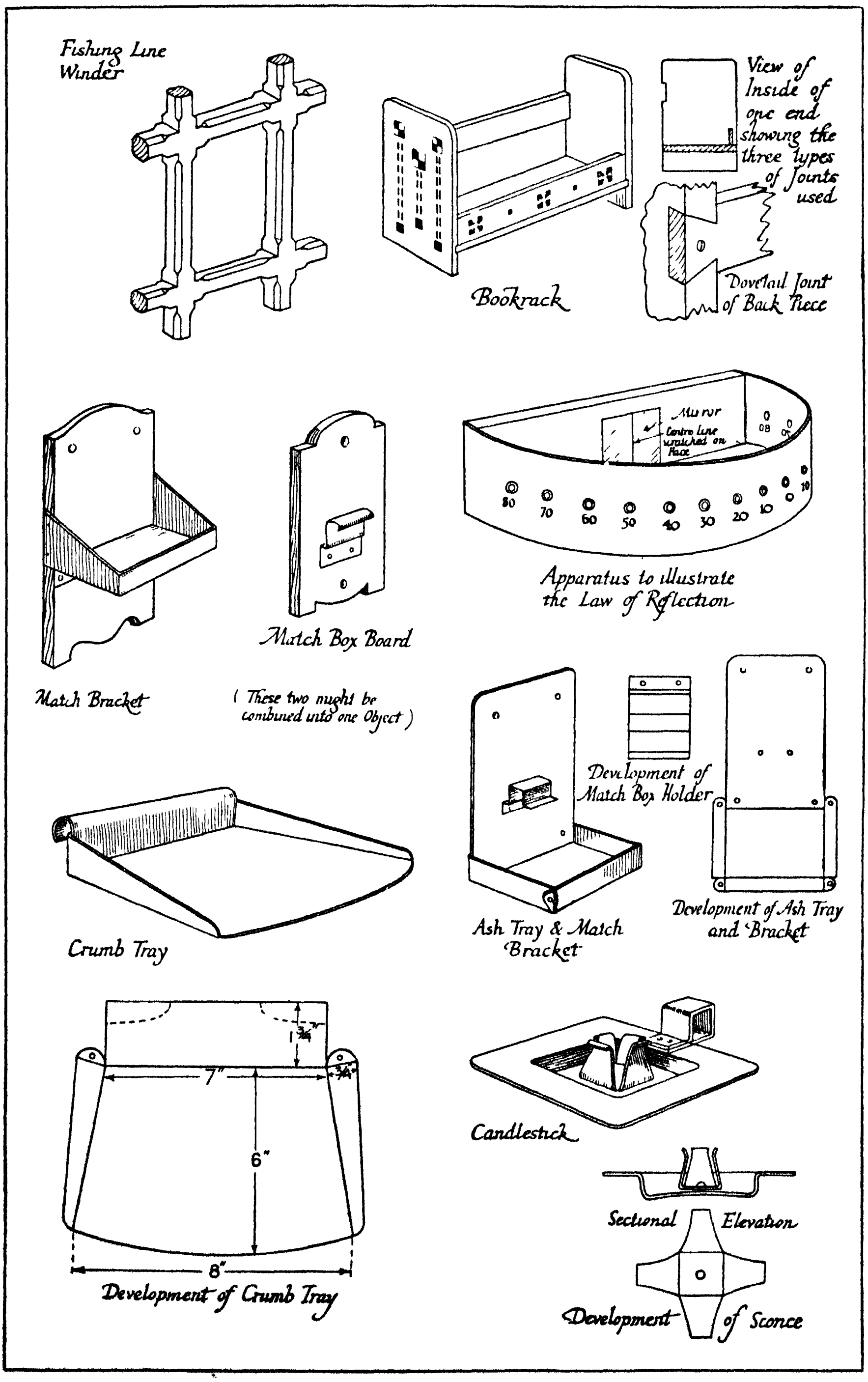

Fishing Line Winder
Bookrack
View of Inside of one end showing the three types of Joints used
Dovetail Joint of Back Piece
Match Bracket
Match Box Board
(These two might be combined into one Object)
Mirror
Centre Line scratched on Face
0
0
80
10
80
70
60
50
40
30
20
10
0
10
Apparatus to illustrate the Law of Reflection
Development of Match Box Holder
Ash Tray & Match Bracket
Development of Ash Tray and Bracket
Crumb Tray
1¾"
7"
¾"
6"
8"
Development of Crumb Tray
Candlestick
Sectional Elevation
Development of Sconce

Fig. 6.—Examples

with the science teacher? If he does, how far shall the needs of the science syllabus be allowed to monopolize the time-table of the handicraft room? The most important moral principle involved is that of co-operation. It is essential that we break down the habit of considering each subject as being in a watertight compartment. Education is essentially one, and our specializations are simply matters of organization for the more effective teaching of the subject-matter. Co-operation is, therefore, fundamental.

Admitting this, we are in danger of opening the door to an amount of illustrative work that would flood the handicraft room, and would effectively prevent any other work being done. This at once reduces handicraft to the position of a " handmaid ". Its practice would become of secondary importance, and merely an aid to other subjects. This is so far from being desirable that we cannot go to this length in an attempt at co-operation. Handicraft is of basic importance. It has a real value of its own, and must be practised for its own sake, and for its own values. Thus we must limit the time we can afford to spend on illustrative work in the handicraft room.

There is another reason for this limitation. It is now generally being agreed that the handicraft room in a school, or a centre serving several schools, shall devote its energies to woodwork and metalwork; not too rigidly, perhaps, but certainly in great measure. Illustrative work calls for a much wider range of materials, and so the two objectives are not quite the same.

Co-operative and Group Work

At one time single objects constituted the whole of the scheme, i.e. objects made by one individual only. When the set, logical scheme was gradually superseded, it was found that, under the greater freedom of a more flexible scheme, objects might be suggested that took more than one boy to make. This gave rise to co-operative work. It has great value, inasmuch as it induces and develops mutual help; it enables large objects to be made; it encourages the growth of the team spirit; it gives wider opportunities for the planning, on a large scale, of objects which are made to fit a real purpose. It gives, also, opportunities for discussion in respect of methods of construction.

First of all the purpose of the object to be made has to be appreciated. The need of it has to be felt and recognized. Then the sketch is made, perhaps by the group leader, following upon discussion by the whole group. This sketch can, in some cases, be used as the working drawing. It will be dimensioned, and the materials to be used will be detailed. This will give rise to discussion between members of the group, and between group and teacher. Then the materials are cut out, and the work begun. Following this comes the " setting out ". All this will be under the direction of the leader, acting under the supervision of the teacher. The joints are made, shapes cut, and the work of assembling the pieces and fitting the joints follows. There is always opportunity for division of labour, so that all the units of the group are employed. This will be the job of the leader. Group work possesses the advantage that large objects such as form the subject of its activity are made for real use, and, consequently, must be finished in all respects. Thus each object must be considered as a complete whole, and not simply as a job in wood or in metal. Included in it may be glass, perforated zinc, wire netting; solignum, or whitewash, or paint; locks, hinges, catches, hooks and eyes, felt, tar, rubberoid, bricks, concrete, asbestos, and other materials. Resource, initiative, invention, are called upon the whole time.

Vocational and Utilitarian Work

Much has been said in favour of education being general, and not particular, in character. It has been widely agreed that a general training is the only training possible for children in the early stages of their school life. A time, however, comes when the dawning intelligence of the child must have work that is more defined in form than can be offered by a general course. The child's intelligence needs an object upon which it can concentrate; it must have something in particular to " bite at ". With the 14's and 15's this is especially the case. A " general " training leads in no definite direction, it has no individual meaning; often enough its vagueness prevents the child taking any interest in it. If, however, we give our course of work a definite and particular objective, the value of which the child can recognize, we establish sustained interest that results in real progress. In handicraft the need for this particular objective which crystallizes a *general* into a *particular* course is a real necessity that increases with the child's age. It follows that the " educational " aspect of the handicraft course should be confined to its earlier stages, and that its later forms should correspond more nearly to life, and the child's environment. This brings into the field of view those aspects of the work known as " utilitarian " and " vocational ".

Utilitarian work has this advantage over the formal " general " type that it deals with reality. The real things of everyday life are introduced and used as objects which, while serving the purpose of utility for which they were originally planned, at the same time allow training in tool operations and manipulation of materials, as well as general development, to be involved in their manufacture.

As boys come to fourteen and fifteen years of age, it is difficult to see what work other than this can be given to them. They have already had training in tool operations, constructive processes, and the manipulation of materials. They are keen to do something that really can absorb their wider activities and greater needs. To cramp their activities at this stage is to be avoided. Purely formal work would cramp them. Freedom for expansion is a vital necessity at any time.

It is sometimes argued that utilitarian and vocational work is not educational; that it smacks of the factory and of reproductive commercialism. The process of education never ceases so long as the individual has to exercise thought. Thoughtfulness is bound to be engendered by dealing with new problems such as are offered by utilitarian and vocational work, which, after all, arise out of life itself. One warning, in this connexion, must be given. There is always the danger that work will be reproduced from plans in the making of which the child has had no share. It may be said that the lines and proportions of the real objects of life have already been determined by the experience of ages; that, for example, a chair is bound to be of a certain height and size generally, and that, therefore, no room exists for alteration, even if it were desirable. On the other hand, it is quite certain that one of the main purposes of handicraft is to generate and develop thoughtfulness, reasoning, the power to plan and to compare, and judgment in fitting to purpose. Any work in which senior children take a share should be the considered work of the children taking part in its making.

The best way to accomplish the foregoing is to look upon all the course work as a series of problems. The terms and character of the need are stated and the methods of meeting the need are discussed. For example, let us suppose that work tables are required for a practical room in a school (a need that is often felt) and it is considered to be a legitimate job for the boys to undertake. Here we are faced with a whole series of problems. Let us deal with some of them.

(*a*) *How large, in their general proportions, should the tables be?*—The size is conditional upon the number of children in a class, the space available for tables, the size and shape of the room, the number of sections in a class it is proposed to establish, and the weight that can be moved readily by the boys.

(*b*) *What should be the height of the tables?*—This is determined by the general average height of the children; but allowance must be made for children taller or shorter than this, by higher benches or footboards.

(*c*) *What should be the width of the tables?*—This is dependent upon the space required for materials and tools as well as for the working space.

(*d*) *Should the tables have drawers, or shelves?*—This is governed by storage needs for stock and for drawings, work in hand, and tools.

(*e*) *Should the tables be stained or varnished?*—It is often an advantage for this to be done, and the reasons can well form the subject for discussion.

(*f*) *Should folding tables be used?*—The room, in some schools, is used for other purposes. In this case folding tables are an advantage, and the particular kind of folding table again will be the subject of discussion.

It is evident that sufficient material is at hand here to give rise to thoughtfulness, resource, invention, reason, balancing of pros and cons, and discussion generally of ways and means.

It may happen, as in the case of a bee-hive, that sizes, shapes, and general arrangements have become more or less fixed, and cannot easily be altered. Even so, it is better to go through the needs of the case, and show why these arrangements are what they are. Thoughtfulness is still induced by this method. It can quite truly be said that the aim of handicraft should be educational, and that, in fact, at no time need the processes followed be anything else, even if they be vocational or utilitarian also.

The Time to be spent on Practical Work

Practice in this respect varies considerably. Opinion is, however, rapidly coming to the conclusion that more rather than less time will have to be spent on it, and that in the case of the fifteen-age group, a very great deal more time will have to be allocated, even to the extent of an intensive course of some months, which would take the greater part of each week's time. It has often been thought by teachers trained under older methods that no time for practical work can be spared from the subjects employed to secure what has generally been considered a sound intellectual training. The experience of some schools who have adopted the more practical methods of teaching certainly goes to disprove this contention. Not only does the academic work not suffer, but, on the contrary, it really improves. This appears to be due to the greater stimulus given by practical work to the child mind. There is also a greater elasticity and freshness of mind which brings about greater accomplishments.

These statements are supported by facts. An investigation of school reports showed that schools taking a considerable amount of practical work had good reports on the academic subjects, and no diminution of standard was shown by any one of them although the time for academic work had been cut down. This is illustrated by the discovery by a particular headmaster of what had happened in his own school. This was a large mixed non-selective central school. The first three years' programme was almost purely academic with very little practical work. At the end of the three years, it was felt that the academic results were not so good as had been expected. The headmaster himself decided upon a change over to more practical work, both in the handicraft room and in the main school. After the first year's working he found that the academic subjects, so far from suffering because of the diversion of so much time to practical work, were brighter and more efficient.

It is interesting to note, too, from a general survey of history, that periods of great intellectual development and accomplishment were attended by similar achievements in the realm of craft. Dr. Ballard in a pamphlet on *The Cultural Value of Handicraft* says: "The era that produced a Sophocles also produced a Phidias; Dante is matched by Giotto; and Cervantes by Velasquez; and while John Milton wrote gloriously in verse, Christopher Wren built gloriously in stone."

The regulation time usually allowed for practical work is one session per week. Usually, this means 2½ hours per week. This does not include any time spent on teaching other subjects by practical methods. It refers entirely to craftwork done in handicraft rooms. When, however, we read the Hadow report and the *New Prospect in Education*, it is difficult to avoid the conclusion that this short period is quite inadequate. The opinion is growing that there should be a cutting down of time spent on work of purely academic interest which has little contact with everyday life. An allowance of one whole day a week might perhaps be regarded as a fair proportion of time to give to handicraft. Later it may be that intensive courses can be arranged for those going into industry, not as special preparation for any one craft, but as a general training.

The " B " children could have arranged for them more time than this. Practical drawing will be included in the allocation of time for handicraft. In the case of retarded children more time still can be arranged. It is of little use to spend the time and energy of the scholars and the teachers in trying to teach what cannot be learned. A topic of interest selected and taught intensively is full of greater possibilities than more general instruction spread evenly and mechanically over the usual curriculum, for children who have no interest in that topic.

Free Time out of School Hours.—In some schools a practice is in vogue which renders great help. It takes place outside school hours, is rendered possible by voluntary service, and takes various forms. One form is to allow boys the privilege of coming back after school hours to the handicraft room, for an hour or two on one or two days a week. During this period they may use the school tools, and make what they wish from their own materials. There is no formal instruction; criticism may be asked for, and may come from the boys themselves; but the teacher is present as adviser, and not as instructor. Sometimes a period is set apart in school time for " free work ". There is a real value in this free time, and under such conditions an atmosphere is created that is productive, with some children, of the very highest expression of art and craft.

Hobbies

How far should a boy's hobbies be incorporated in his work? There is very little reason for exclusion. The fact that a boy has a decided and definite interest of his own is a factor of which use can and should be made. If it is one that can be used in the boy's handicraft course, we have the great advantage that the boy is working with us with definite intention, and with a much greater zest than if the interest had been supplied from an external source. Freedom is necessary to progress. There is no hard, logical, unalterable course that has to be laid down for each individual, and along which children will make progress automatically. Each child tackles his job in a different manner. Some quite easily adapt themselves to an external scheme, and often become quite helpless unless there is such an external supply of ideas. Others do not find an external scheme of sufficient interest to stimulate them to any great activity, but have, springing up within them, ideas seeking expression. If these children are denied the opportunity of such self-expression, their efforts tend to wilt and die. This is an additional reason why a boy who has a hobby should be allowed to incorporate it in his work.

There is another reason. Hobbies being pursued individually are often practised alone. It does often happen in such cases that construction is wrong, and many other faults can arise. If these are committed in the handicraft room, the teacher has the opportunity of giving advice and instruction. At the same time the spirit of hobbies is the freedom of self-expression, and this spirit must be encouraged and not checked.

Repairs

There was a time when repairs were considered to be outside any scheme of handicraft. They belonged to the domain of the tradesman. There is, however, such a great amount of valuable training in repairs that under the new conditions it is not surprising that they are being considered as part of a boy's work. It is not, however, possible to include repairs *ad lib.*; i.e. repairs of any kind and in any quantity. Discretion must be used. It must also be noted how much of any individual boy's time is taken up on repairs, and how far the time that is so taken up is of value to the boy.

Repairs undoubtedly call for resourcefulness and thoughtfulness; initiative is developed, and inventiveness must be shown in solving the many problems that repairs offer, and that are out of the beaten track of a logical scheme. The " general " scheme is slowly developed tool by tool, and process by process, by orthodox and conventional methods. Repairs, however, bring the boy up against problems that are unforeseen, and for which no orthodox method can be taught. In short, the boy is up against life, and an immediate call upon his resources has to be made to solve the problem. It is this aspect that makes repairs a valuable part of a boy's training, if used with care and discrimination.

In one secondary school known to the writer, the work of one form definitely allows time for repairs. These include broken desks, forms, stepladders, clothes-horses, pastry boards, T squares, locks, glazing windows, repairing electric bells, chairs, and similar objects. This form is well up the school. When any repairs do come along, the boys lay aside their standing work and tackle them. Each boy takes his due share, and they usually work in groups. When the repairs involve new methods, or require special thought, the whole form takes part in the discussion, and opinions are invited. The teacher remains in the background, ready to help if necessary, but no help is given if the boys can suggest the right methods.

CHAPTER VII

Handwork in Relation to Other Subjects

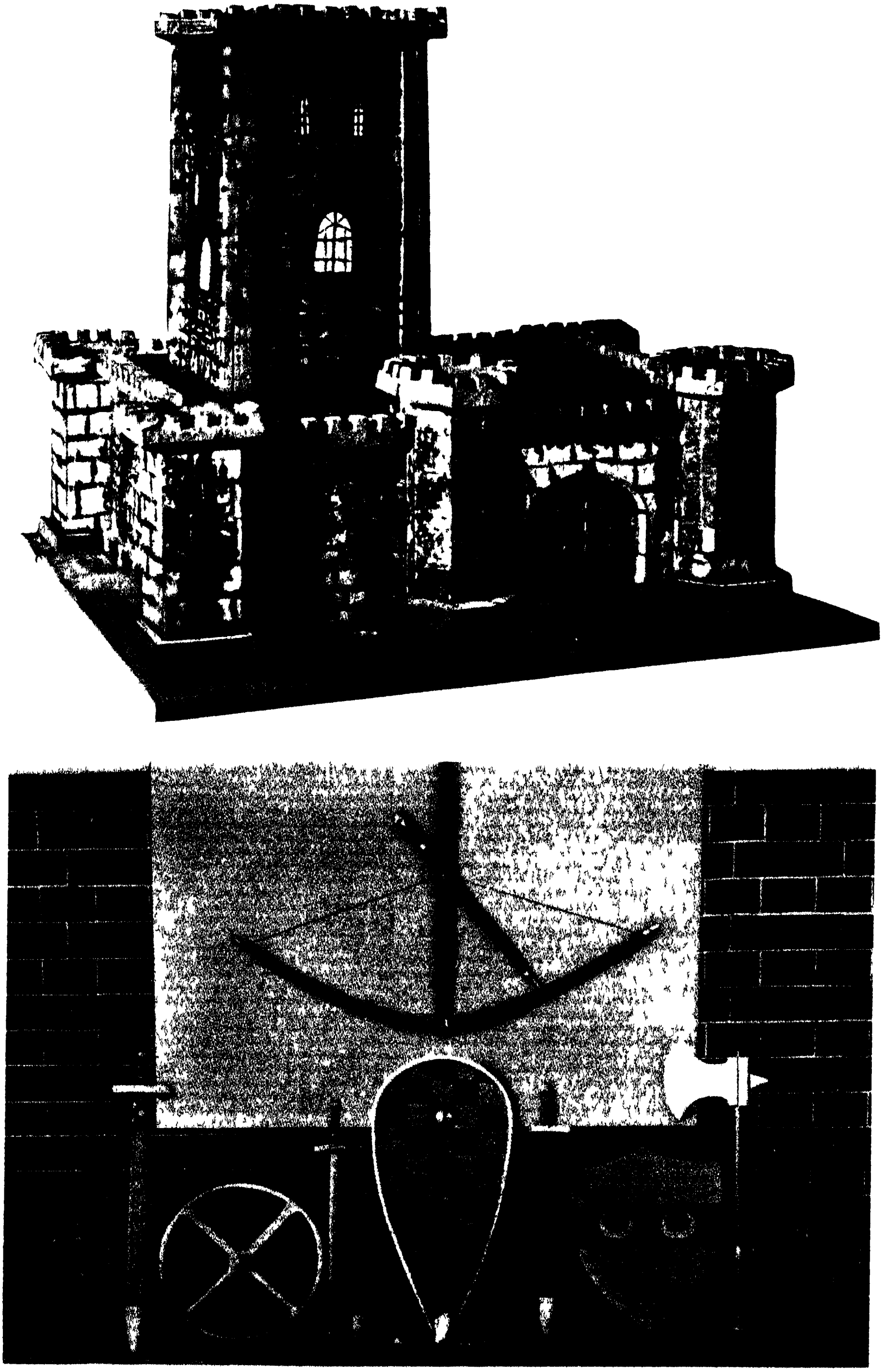
No special time need be allocated specifically to illustrative handwork. Geography, for example, is now taught largely by practical methods; it is still geography and not handwork; so with other school subjects.

The academic needs being the greater, the handwork is subordinate. Handwork is a method of approach, and is used frankly as a teaching method. In this respect it *is* the " handmaid " of the school subjects and is rightly so used.

The arrangement suggested involves the fitting up of a room for practical work of a general nature, apart from the usual handicraft room where woodwork and metalwork are done. This extra room should be stocked with a wide variety of tools, and fitments, and materials. Wall benches are a convenience; they give more room. Equipment will include tables for sheet metal work, and for paper and cardboard work; a blowpipe for glass blowing; and a brazing hearth, with blowpipes and bellows for hand soldering and light forging. The wall benches should be fitted with vices for wood and metalwork. The flat tables, or table desks, will be suitable for leather-craft, raffia-work, perhaps needlework, and so many other of the practical activities of the school. With regard to tools it is a wide variety rather than a large number of each kind that is needed. As well as artificial light, water should be laid on; it is needed for clay modelling, casting in plaster, basketry, and raffia-work. A deep sink should be fitted. Bunsen burners are needed for leather-work, bookbinding, and basketry; gas rings for heating water and glue, and making paste; and a gas soldering stove for soft soldering in addition to the brazing hearth previously mentioned.

Rural Areas.—A safe guiding principle in the preparation of schemes is that the constituent parts can be drawn from the child's environment. By so doing, the scheme can be coloured to a large extent by the occupations of the district. Children can realize more easily the value of their work when they recognize readily the use of the objects they are making. Where these make easy contact with their environment, and often with their daily life, this value is emphasized. In rural areas particularly, everyday life provides so many objects for inclusion in a handicraft scheme that we can have little hesitation in basing our schemes for rural schools upon rural occupations.

THE SCHOOL GARDEN.—Probably the first channel through which the child will feel the influence of local occupations will be the school garden. With the garden a very large amount of genuinely suitable school handicraft may be associated. Gardening and handicraft form one of the oldest combinations known. The first job in gardening is to define the limitations of the plot. At once the need of a line is evident, and a line suggests a *line winder*. The ground has to be dug, and the spade must be cleaned; hence a *spade scraper*. Seeds are sown, and a *seed drill* is needed. The seeds attract birds, and *seed guards* are therefore called for. To protect young plants from the sun a guard of some kind has to be devised. The young cabbage plants need setting, and a *dibber* is needed. The plots need numbering, and a *number board* can be made. *Plant labels* are necessary; and so throughout the whole process of gardening, handicraft can offer substantial assistance. The handicraft called for will suit all ages of boys,



HISTORY MODELS MADE IN THE HANDWORK ROOM

and all their stages of development. Some of the work is simple, some advanced, and some of it constitutes admirable opportunity for group and co-operative work. Many of the objects can definitely be incorporated as prescribed work in a scheme of rural handicrafts. These can be the subjects of discussion, and used as a means of training in thoughtfulness, reasoning, resource, and judgment. The larger pieces of work may be done by the teacher and the children working together. This work will include cold frames, hot frames, gates and fences, tool sheds, pergolas, garden huts and seats.

A METEOROLOGICAL STATION.—This is a necessary equipment for a rural school. It will be placed in the garden in a suitable position. The making of the constituent parts can form part of the boys' extra activities. Much of the second, third, and fourth years' work will be of the nature of extra work that is not a prescribed and rigid part of any scheme, but arises out of the needs of the school curriculum. This piece of work comes under such a head.

First there is a need for measuring the rainfall of the district; we must make a *rain gauge*. The intelligent appreciation of the method of calculation involved will come through making rain gauges of varying sizes. The direction of the wind must be known, and a *wind vane* suggests itself. The measurement of the speed of the wind gives rise to an *anemometer*. *Thermometers* can be made; and in any case they need protection, and a screen is made for this purpose. It is possible and profitable to have *sun-dials*, both vertical and horizontal. Apparatus to measure the sun's height each day, and to form a graph of its path during the year can be made also.

BEE-KEEPING.—Many rural schools have adopted bee-keeping as one of their activities. Arising out of this comes a wide variety of practical work that is of great value. Bee-hives, and stands, and the internal fittings will be a very fit object for school handwork.

VOCATIONAL TRAINING.—Following up the work arising out of the school garden come other larger needs. In view of the raising of the school age, and the influx of a larger number of children, the needs must be considered for the purpose of seeing how far they may be drawn upon to serve our purpose. Poultry-keeping may be a school activity, and out of it will arise a large amount of handicraft that can be done co-operatively. Chicken-coops, foster-mothers, hen-houses, and other similar objects can form part of the work of the older boys. The making of these objects involves the use of wood and metal, glazing and painting, tarring and otherwise finishing the surface; the use of corrugated sheeting, felt, or rubberoid. In this way a wide experience in the tools and the materials of industry, and in the methods of industrial practice is obtained.

In rural areas many children will eventually follow rural occupations, despite the drift to the towns. It may be that the centralized schools will tend, by giving a wider syllabus, and by touching a much larger percentage of the rural population, to show children a way to the towns, by giving them an education that fits them more for a commercial or an industrial rather than an agricultural life. Nevertheless rural pursuits will claim some.

The connexion between rural practical work and the school can be far-reaching. The practical work offers opportunities for practical drawing that are unique; for the costing of the objects made, and of the garden produce; the cost of seeds, manure, chicken food, and the marketing of the produce. The science of the school can well be arranged round a practical scheme based on rural occupations.

School Plays and Handicraft.—One of the best ways of emphasizing the teaching of history and literature is by means of dramatization. Children dramatize key events in history, or incidents in literature. Dresses and property can be made, and thus different forms of handwork are called for. Dramatization can be used also in the wider sense of school plays for public presentation; and a large amount of handicraft arises therefrom, involving the use of a wide range of materials. The making and painting of scenery give opportunities that are extremely valuable for the development of initiative and inventiveness.

Co-ordination with Handwork.—We are often told that education is one whole, and that we must avoid watertight compartments. Co-ordination must so act that the school moves forward as one complete organism. Great efforts have been made to get the handicraft room to co-operate with the school. It is not so often realized how the school can co-ordinate its work with the needs of handicraft. When we turn our attention to the matter it is really surprising how much help the school can give in this respect.

COMMERCIAL GEOGRAPHY.—The general information on timber sometimes called for in the workshop is not found in its entirety either in geographical or any other textbooks. Here is an opportunity to effect a sound co-ordination. The teacher of handicraft has two courses open to him. (i) He can give the list of facts required to the geography master, and give him indications where the information can be found. (ii) He can himself arrange to give the information during the geography lessons, by arrangement with the staff. It will be realized by the boys that this part of their academic work, arising as it does out of their practical activities, has a meaning and a purpose that compel their attention. Their subsequent acquisition of this knowledge will be more satisfactory and certain because it does so arise. We suggest an outline for teaching purposes.

Timbers.—(*a*) What woods are used in the handicraft room?—red deal, yellow pine, canary wood, satin walnut, oak, mahogany, walnut. (*b*) Where do these grow?—leading to the distribution of soft and hard woods—and why this is so. (*c*) How these are felled—lumbering and lumbermen; how transported—by river, lake, road. (*d*) The conversion of timber—sometimes on the spot, sometimes after transport. Sawmills—the power needed. (*e*) The seasoning of timber—natural and artificial. (*f*) The marketing of timber—ports of shipment, steam-ships, and routes. Home ports and methods of storing and distribution—rail and road and canal transport. Home timber yards and sawmills. (*g*) Some reference to the manufacture of doors, windows, floor-boards, furniture, shop fitments, &c., by hand and by machinery.

Metals.—The treatment of these would follow upon the same lines.

Tools.—The materials of which they are made; why these materials are used in their particular places; source of origin—mining, production, manufacture, marketing. Distribution.

BOTANY.—The growth of trees, the parts played by the roots, cells, sapwood, cambium, inner and outer bark, leaves, and all the other various parts of a tree, in the tree's life. The structure of trees of various kinds used in the handicraft room; the reasons for their shape and for their habits. How they can be identified, (*a*) growing, and (*b*) as timber. Their use in both states. Defects, decay—blights, pests and fungi that attack them.

BYE-PRODUCTS.—Bark for tanning, resin, Stockholm tar, charcoal, cork, bast, woodpulp for paper and cardboard making, dye, sugar, rubber, quinine, turpentine, creosote, pitch, lamp black, castor, olive, eucalyptus oil, pearl ash, inks and the various processes of manufacture.

CHEMISTRY.—Soldering processes both soft and hard can be the subject of lessons—what constitutes an alloy—why they are made and used—how substances with entirely different properties from the elements from which they are made are produced. The importance of various melting-points in solder. Fluxes and how they are made, why used; the chemical changes that occur. Cleaning and colouring liquids and acids—how they do their work. Brass, pewter, aluminium, copper, zinc, silver, steel, mild and cast, wrought iron, and other metals.

The changes that occur in the hardening and tempering of tool steel. The making of paint, and the actions of boiled and raw linseed oil, terebene, and turpentine—how varnish is made—French polish—the making of lac—the action of methylated spirit. Glue and glue size.

MECHANICS.—The mechanical principles underlying the construction and the use of various tools. The wedge and the lever are chiefly concerned. The bow saw, hand and tenon saws, plane, chisel, hammer, pincers, screw-driver, brace, drills, cold chisel, carving tools—why some cutting edges are thick and others thin—the cover iron on a plane and why it is necessary—the gimlet and the bradawl—the action of a file contrasted with the chisel and saw—how inertia acts in knocking out the wedge and iron of a plane—the right angles for various saw teeth—the elimination of friction by consideration of the angle of clearance.

PRACTICAL DRAWING.—The drawing that is done in the handicraft room should be confined to the production of the drawings that are necessary for the work actually to be executed. The boy should prepare this with the minimum of tuition in the handicraft room. The formal teaching of the principles and practice of drawing should be done in the classroom. Practical drawing is suitable for younger children, but it will be continued in the senior school. There will be geometrical drawing, scale drawing, the making of plans and elevations, sections, the drawing of solids and their sections, the projection of lines and points (see pp. 197–202). In the art side of drawing the pupil will be taught hand sketching, object drawing and design, especially pattern. In the latter ample opportunity occurs for geometrical drawing. Connexion might be kept with the handicraft room by using objects from it. The formal drawing should never be allowed to become divorced from the practical work. The study of problems for the sake of the problem itself, whilst of great interest, often results in isolation.

The best way to keep a sound connexion between the technical drawing of the school and the handicraft room is to arrange that this shall be given by the handicraft teacher. He is an expert in practical drawing, and it seems to be a natural proceeding that he should give formal tuition in drawing to a whole class, and take the same class in handicraft. He can also render service by superintending, or mapping out, the course of practical drawing in the contributory junior schools. Continuity will thus be assured.

THE HISTORY AND LITERATURE OF CRAFT.—Now that the crafts are becoming so closely associated with our school life, their history and the literature connected with them are matters that are the concern of the school. History should begin with what is close at hand. All crafts have histories connected with the history of man; the history of craft is, in a real sense, the history of man. To trace the histories of bookbinding, wood- and metal-working, raffia-work, basketry, clay and pottery modelling, weaving, leather-craft, with all of which children have contact, and in which therefore they have a living and an abiding interest, should be of great value to the school. Connected with the history of craft is a literature. This is, at present, not well provided for in textbook form. *Craftsmen All*[1] is a book that can be mentioned in this connexion.

CHAPTER VIII

Suggestions for Schemes

It is generally agreed that schemes should make provision for two things: (*a*) a training in technique, and (*b*) the development of the boys' creative powers.

For the purpose of gaining technique, i.e. the knowledge of tools and their possibilities, materials and how they are manipulated, certain parts of the course are definitely and formally prescribed. This means that selected objects are made to embody certain tool operations, constructive processes, and materials. They are specified in respect of sizes, shapes, construction, and materials, so that the student may cover the whole of the necessary technical ground, and may become proficient in the arts and practices of the various crafts.

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[1] Dryad Press.

For the development of creative power pupils are encouraged to suggest work that arises out of the various needs of their own life (see p. 175). The second consideration is more important than the first, and it is essential to keep this in mind, because the purpose of practical instruction is not exclusively that of mastering the technique of craft. Each child must be allowed to use his own initiative and resource. A certain freedom is necessary for this, which a perfectly rigid course would not allow.

The Technical Part of the Scheme.—Throughout his whole career a boy will be gaining technique. Instruction and training will always be taking place. Usually, however, it is considered necessary that at the commencement of his handicraft experience he should have a preliminary training course that is purely technical. The length of time that this should occupy varies. It will bear relation to the general progress of each boy. It will not last until the boy has become proficient in the use of tools; that proficiency will come only gradually, and many boys will not so become during the whole of their three or four years' course. This preliminary technical training only introduces boys to the tools and materials, to the difficulties encountered in their use and manipulation, and how tools and materials should be used to overcome these difficulties. A period of six months should on an average be sufficient for this. With some boys a few weeks are sufficient, while with others it is possible that a longer period than six months may be necessary.

It should not be assumed that all the technical training a boy will ever have will be confined to this period, and that for the rest of his time he is doing just what he likes. Training in technique goes on all the time, and it is necessary from time to time to give prescribed work and definite instruction in tool practice in all stages of a boy's handicraft career. Some boys are full of ideas and suggestions, and it is imperative that their enthusiasm should not be damped by an insistence upon purely technical training. The teacher's judgment has to be exercised carefully in this respect. A constant supervision is necessary to see, on the one hand, that no boy becomes discouraged by failure, or develops bad tool technique by attempting work beyond his powers, and on the other hand, that no boy is kept back or unduly restrained from following his natural bent.

Woodwork.—The ground covered by this technical course of training is a matter of the greatest importance. It is possible to lay too great a stress upon the tool operations involved, and to conceive a scheme that is trivial and uninspiring in character. Generally speaking, there are three chief cutting tools whose mastery should be the object in any preliminary scheme—the plane, saw, and chisel; subordinate to these are the try-square, ruler, and marking knife. If these are used as the basis of the preliminary technical scheme, enough will have been done to afford a satisfactory introduction to the woodwork course. The use of other tools will arise in carrying out work suggested by the boy, and his previous personal experience will dictate his line of approach to them, aided by what he has seen being done by other boys, and by his teacher's personal and individual tuition.

For an effective training in the use of the chief cutting tools, certain definite articles, whose sizes and shapes are specified, are necessary. These should be real things, arise out of real needs, and as far as possible out of the environment of each boy.

Suppose we decide upon six objects as forming the preliminary scheme. Each of these should embody certain definite tool operations, though in each case several alternative objects might be specified. For example, to illustrate the " housing " joint, quite half a dozen simple objects can be given from which a boy can make a choice.

Joints.—A knowledge of joints is indispensable. In woodwork the following joints cover a wide field of work: (*a*) the housing joint; (*b*) the half-lap joint; (*c*) the bridle joint; (*d*) the mortise and tenon joint; (*e*) the dovetail joint; (*f*) the glued butt joint; (*g*) the grooved and feathered joint. It is not necessary that these should be incorporated in the preliminary technical course. Perhaps the first three may; the others probably later. It is essential that good examples of completed joints are available for the boys' personal examination, and of drawings that show quite clearly the various stages of the work. The same applies to metalwork. All joints should be shown by practical examples; and as many stages in the production of these as is possible should be shown.

Each year an effort should be made to keep this preliminary course fresh and up to date. A point should be made of substituting at least one fresh alternative object in each series every year. Keep well in mind the fitness of each object for its real purpose, and its artistic value. Each should be a real article, and of real attractiveness.

The Development of Initiative.—The greater part of the work done should come under this head. After the boys have been introduced to handicraft through the medium of the preliminary course, they will proceed to execute work (*a*) of their own suggestion, and (*b*) of a comparatively advanced nature that is fitting some recognized need. This throws upon them the considerable responsibility of choosing work that will fit its purpose, and of constructing and finishing it accordingly.

In determining the line of approach care and judgment are needed. In the first place all work should make a definite demand upon thoughtfulness. It is this that distinguishes practical work which is educational from that which is commercial and reproductive. When thoughtfulness ceases, mechanical reproduction begins and as an educational process the work has little value. There are two guiding principles that will help to determine the procedure. These are (*a*) fitness for purpose, and (*b*) æsthetic satisfaction.

We can imagine the procedure to be somewhat on these lines: The boy suggests, say, a clothes-horse as an article needed in his home. The teacher then suggests that there are two courses open to him: (*a*) he can measure up an existing clothes-horse, or (*b*) he can decide upon the shape and measurements by considering what the purpose of the object is. By the first method he carries on tradition. By the second he ignores tradition and begins work anew. If he follows tradition he makes use of previous human experience. This saves much time and thought. On the other hand it is possible that the traditional method may not fit the purpose as well as it might do.

It is well therefore to consider the problem afresh. The following are relevant questions and comments that will indicate the method. Is the clothes-horse for large or for small articles? What is the extent of the family laundry? The answers to these questions will determine the size of the horse, and the number of folds. How should the folds be hinged? As the clothes need airing on both sides, the folds should fold both ways easily. We therefore need screen hinges. These must be of brass or of webbing. Why? The hinges must be rustless. Again, since the clothes take up a certain thickness, and therefore, when the horse is folded, tend to prevent the folds from coming together, how may this be prevented? By making the rails somewhat thinner than the stiles. A particular garment when hung over a rail takes up, say, about 18 in. of length; how does this affect the construction of the clothes-horse? The lower rail must be at least 18 in. high, otherwise the garment would trail on the ground. This also determines the approximate distance between the rails. Lastly, why should the top edge of the rails be rounded?

Needs of the School.—In framing schemes of practical work, allowance must be made for the inclusion of work that will fit the needs of the school (see p. 175). Some of this work is often simple enough to be included in the course of preliminary technical training; some of it provides advanced work for the abler boys.

Science.—Model atmospheric and force pumps, water fountain, barometer, apparatus for water pressure, for levers, and for reflection and refraction of light, for sound and heat, Roman and Danish steel yards, spherometers, gauges, proportional calipers, verniers, periscopes, kaleidoscopes, magnetic compasses, magnetometers, electric candle, magnetic wind vane, telephone, wireless sets and loud-speakers.

Geography.—Plane table, theodolite, sun dials of various kinds, wind vane, rain gauge, spirit level, plumb rule, sextant, optical square, Stephenson's screen, anemometer, eclipse box, altitude finder, geographical clock.

History.—Scenes showing chief events in history to illustrate syllabus; theatres and panoramas; reproduction of tools and weapons. (See plate.)

Bookbinding.—Laying press, finishing press, plough, sewing frames, smaller presses, ornamental punches.

Miscellaneous.—The making of tray and basket bases for basketry; frames for rug-making; boards for clay modelling; flower holders; notice boards; spraying apparatus; school museum; book stands and cases; bone folders; clay-modelling tools. Many of the tools and much apparatus needed in the wood and metalwork rooms can be made also; for example, saw boards, shooting boards, mallets, gauges, solder bit stands, scratch-stocks, mitre boards, routers, steel squares, scribers, calipers.

The garden.—Cold frames, bee-hives, spade scrapers, seed guards, plot number boards, wheel-barrow, gathering basket, bird scarers, garden hut, tool shed.

Games.—Football posts, apparatus for net ball and stool ball, cricket stumps for the playground, trap ball, chessboard, nine men's morris, marble games, hockey stick and cricket bat racks.

The time that should be devoted to school needs depends upon the school, and upon the teacher's enthusiasm for, and interest in, the needs. Perhaps up to one-third of the handicraft time may be spared.

The 15+ boys.—Children become increasingly cognisant and appreciative of the accuracy that is associated with good craft standards. This increases as the child reaches the senior school, and by the age of 15, boys ought to have reached a high standard of craft ability. Such appreciation calls for work of an exacting character.

Furniture-making.—No boy should find himself in advance of what a scheme can offer. For the boys who show exceptional promise in woodwork, furniture-making is the best form their work can take. Its range of work covers such a wide field that it is easily accommodated to the progress of the child. Furniture-making will include, in addition to what a boy has already done, constructions of greater difficulty, the use of a greater variety of woods and tools; inlay, veneering, and overlay; and polishing of various kinds.

Metalwork.—Some boys find that metalwork affords them the most scope; at 15 years of age they want something to " bite at ". They can proceed upon two lines of development: (i) the constructive side, and (ii) the art side. The distinction is somewhat artificial, for each should include the other. Construction should always be " art ", and art should always be constructionally sound. Nevertheless, sometimes construction and sometimes the ornamental expression is the dominating factor. The latter has this advantage, that it often meets the needs of the home in greater measure than the former. The objects that can be made are many. Finger plates, trays of various kinds, match stands, fire-screens, inkstands, photograph frames, letter racks, pipe racks, fire curbs, fire irons, candlesticks, electric light fittings, handles, nameplates, hinges, bowls. The making of simple jewellery, brooches, clasps and buckles in various metals, can, in the hands of a capable and enthusiastic craftsman, be successful. Simple enamel work may be included for the older children.

Outline of Schemes that have actually been in Use

These outlines are given in the hope that they will afford an indication of what may be done in senior schools. The objects [1] named have been selected partly for their suitability for training purposes, partly for their utility.

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[1] Some of the articles in the following lists are illustrated on page 177.

Illustrative Work: (*a*) GARDENING:—Spade scrapers, line winders, garden dibbers, seed guards, plot numbers, seed markers, drill, sprouting box, step-ladder, cold frame, wheel-barrow, garden hut and tool shed.

This formed the scheme of work in wood and metal to meet the needs of the school garden in a rural school. It included glazing, painting, and treating with preservative.

(*b*) OTHER RURAL NEEDS.—In addition to the gardening scheme, some districts need work that is allied to other rural pursuits such as poultry rearing and small farming, dairy farming. Such articles as a milking stool, chicken coop, saw stools (for logs), bee-hives, hen-house, foster-mother are suitable.

(*c*) METEOROLOGICAL STATION.—Wind vane, board for records and graphs, sun's altitude finder, rain gauge, Stephenson's screen, fence for the station, vertical sundial, anemometer.

(*d*) GEOGRAPHY (SURVEYING).—Staves, angle measurers, mirror altitude finder, plumb rule, spirit-level and water-level, chain, plane table, cross head, apparatus to get a north and south line (*a*) by the sun, (*b*) by pole star, latitude finder, theodolite.

(*e*) PHYSICS.—(i) *Mechanics*: illustration of inertia, Archimedean drill, box kite, inclined plane, lifting jack (*a*) lever, (*b*) screw, balancing top, cams, wedge apparatus, apparatus for parallelogram of forces, apparatus to illustrate moments, derrick crane (with tension and compression balances), gliding and spinning toys, pendulums, balances, Roman and Danish steel yards.

(ii) *Hydrostatics*: leather and string sucker, submersible submarine, simple chicken feed, Nicholson's hydrometer, experiments with water pressure, atmospheric pump, force pump, water fountain, barometer.

(iii) *Magnetism and electricity*: making a simple magnet, magnetic compass, dip measurer, oscillating magnetometer, galvanoscope, deflection magnetometer, tangent galvanometer, electrophorus, electric candle, electric bell, telephone, electric recording wind vane.

(iv) *Light, sound, and heat*: periscope, kaleidoscope, reflection measurer (two kinds), optical bench, camera obscura, thaumatrope, reflection of mirrors apparatus, whizzer and hummer, xylophone, tin whistle, Wheatstone's kaleidophone, sonometer, single string violin, megaphone, stethoscope, reflection of sound apparatus, apparatus to test conduction of heat, apparatus to test expansion due to heat, apparatus to test expansion of various metals, apparatus to test heat currents, apparatus to illustrate ocean currents, hot-water system in miniature, steam-engine.

All the foregoing belong to the category of illustrative work. They can be worked into any part of a scheme to suit individual requirements, and many of the examples can be worked into a scheme for preliminary technical training. For the latter, however, it is better to have a definite course on the lines suggested on p. 189.

Craft Work: WOODWORK.—The following are suggested as suitable objects to include in the preliminary training course: a block of wood, finger plate, pair of straight-edges, marble board, pen rest, letter rack, garden dibber, fishing-line winder, plant stand, hat peg, pin bowl, watch stand, ink and pen stand, tool box. For these the following tools are required: pencil, try-square, rule, jack plane, gauge, marking knife, tenon saw, chisel, hammer, mallet, bradawl, screwdriver, saw board, shooting board, firmer gouge. The joints that are involved are butt joint, housing joint, half-lap joint, bridle joint.

After the preliminary period is over, the work can be allowed to open out to suit each individual. It will not always be possible to accept the first suggestion made by the boy. The article suggested may be too simple; or it may be complicated; but, if possible, his choice should be allowed. As, however, the teacher is responsible for the continued progress of each boy, it may be necessary, in some cases, to suggest what the boy may make. If this is so, the use of good photographs or reproductions of well-constructed modern furniture is recommended. We cannot expect children, or even adults, to produce out of their inner consciousness what is not there. It is a sound rule that " there can be no expression without previous impression ". Sometimes it is well to specify certain articles, and let the boys work from prepared drawings.

Group work.—This is the stage of co-operative effort. Larger objects call for the united work of two or more persons. Reference has already been made to this on p. 178, and the following list indicates what may be made on co-operative lines: school museum, hockey-stick and cricket-bat racks, fall table, work table, garden seat, bee-hive, cold frame, bicycle shed, garden hut, school pavilion.

Individual work.—The following articles have been made by individuals: carved book rack, palm stand, upholstered stool, Moorish stand, carved fire screen, oak stool with woven Chinese sea grass, tray in basketry with plywood base, box ottoman from packing-case, carved breadboards in sycamore, one in chip and the other in surface carving, chip carved blotting case, dining table in oak, dining chair in oak, bookcase and cupboard in oak, work table in oak.

Much of this appears to be very advanced. The more advanced pieces have been made by older boys who have been given more time than usual for their work. The fact that they were interested with this advanced work proved a great stimulus to them. In every school there are boys who respond to more difficult work. If work is to be well done it must be worthy of the boys' skill.

COMBINED WOOD- AND METAL-WORK COURSE.—No object should be planned to include both wood and metal merely to make something that will come under this head. All articles made should serve a useful purpose, and there should be a definitely utilitarian reason for the inclusion of metal. Usually only sheet metal is used in such a scheme, though articles made entirely of metal are sometimes included.

Articles in which wood and metal are used: match bracket, candlestick, letter rack (the uprights are lined with metal) spade scraper (metal with wooden handle), inkstand (uprights of metal), railway truck (base of wood, body and wheels in metal), a garden trowel (handle of wood), apparatus for reflection of light experiment (wood and tinplate), knife cleaner (metal handle), toast rack (wooden base and metal divisions), egg stand (wooden base and wire framework), calendar (wooden back and metal holder), toilet fitting (wood and wire), bill file (wood and wire), candle bracket (wood back, metal sconce and tray and reflector), soap tray (wooden back and zinc tray), paper knife (metal centre and wooden handle), printing frame (metal springs).

Work done entirely in metal: ash trays (these can be square, round, elliptical, oblong, and in fact any reasonable shape, and of many designs), ash tray and match stand, finger plates, napkin rings, letter racks, matchbox stand, paper knife, crumb tray, candlestick, inkstand, book end, pencil tray, escutcheons, hinge, lamp shade, corner plates, name plate, small pokers, handles for doors and drawers, repoussé punches, cold chisels, centre punches.

This course will include riveting, soft and silver soldering, simple forging of small dimension, metal hardening and tempering, bench and vice work, shaping of metal with hack saw, files, and hammers and mallets, drilling, cleaning, and colouring.

METALWORK COURSE.—The course herewith outlined can be used for the whole of a four years' course, if it be felt that greater benefit will be derived from this rather than from a course beginning with wood and proceeding to metal.

Metalwork can be divided into a comparatively large number of processes which are quite distinct in character. In each of these, preliminary technical instruction must be given, and in each, freedom of choice shall also be allowed in the later stages. The processes are given below, with suggestions under each for individual objects.

Tinplate work.—Seed label, nutmeg grater, swing over, match holder, sugar castor, gill measure, saucepan, megaphone, dripping tin, bread tin, kettle, funnel, cake cutter, cake tin.

Other sheet metalwork.—Ash tray in copper, stencil plate in zinc, fire screen, name plate, book end, shaving mug, kettle stand, centre square.

Brazing.—Try-square in steel, napkin ring in copper, casket in copper, poker handle—point and shaft.

Turning.—Poker handle, centre punch, plumb bob, napkin ring, and many small parts for other objects.

Tempering.—Centre punch, cold chisel, metalwork tools, box opener, cutter for tin opener, wall plug punch, plugging chisel.

Forge work.—Clothes-line hook, set of iron fittings for child's barrow, fireside set, bolt hook, staple and hook, sheet metal folders, carving cramp.

Bench and vice work.—Various gauges, straight-edges, proportional-calipers, hinges, escutcheons, latch, centre gauge, try-square, fire shovel, set small stakes for beaten metal work, micrometer, brush rack.

Tapping and screwing.—Wire fence bolt, poker head and point to shaft, screw jack, carving cramp, bolts and nuts for bookbinding presses, letter weight knob, spherometer.

Sometimes an example may be presented in the form of a problem. For instance: Devise an instrument that will measure very small dimensions. Think of the properties of similar triangles, and make use of them if you can in planning such an instrument.

Waste Materials.—It is well to keep a box in which waste materials can be stored, and turned over when occasion arises. Such things as disused bicycle valves, bolts and nuts of all kinds, tin cans, gas nipples and fittings (especially those with taps), meccano parts, venetian blind pulleys, tin lids, copper tubing, by-pass tubes, and similar materials are all worth keeping for possible future use. But do not allow the waste material to suggest the making of particular objects. It is putting the cart before the horse to consider the material first. The following suggestions are given in the light of these remarks:

The object to be made.	*Possible accessory materials.*
Steam-engine.	Syrup cans and wire.
Spirit lamp.	Boot polish tins.
Storm candlestick.	1 lb. cocoa tin (square or round).
Force and lift pumps.	Piping of various diameters.
Fruit sprayer.	Tin can and bicycle valve.
Micrometer.	Finely tapped bolts and nuts.
Nutmeg grater and holder.	A 100 cigarette round tin.
Specific gravity test.	Cocoa tin.

ART METALWORK COURSE—This is largely a matter of equipment. Much work of a simple kind can be done with equipment of a very moderate character, though, of course, it is better to have all the appropriate tools. A hammer, a few nails for punches, a few odd ends of bar mild steel for stakes, a piece of lead or even wood for a modelling block, together with a few files and a pair of shears, suffice for the production of some good work. Wood shaping mallets can be made, and soft solder can be used with a home-made blowpipe. With a supply of pitch blocks, shaping hammers and mallets, stakes of various kinds, forge or brazing hearth, colouring and pickling bath, drills, files, saws, and a few other tools, a wide range of work is available.

CHAPTER IX

Drawing

Drawing is not only a first necessity in the execution of handicraft, but can be, in itself, a great factor in a child's development. It has already been mentioned that the curriculum of the junior school should include practical drawing. This will be simple in character, but will be co-ordinated with the drawing of the senior school, so that the work done in the latter will follow on naturally. Every normal child coming into the senior school should be able to measure to ⅛ in.; to construct simple plane figures such as triangles, squares, oblongs, circles, hexagons, and octagons; to do some simple geometrical design; and to make elevations and plans of simple objects. An excellent method of achieving this result is to have a continuous scheme of paper and cardboard work in the junior school.

Dimensioned Sketches.—These are of two kinds: perspective sketches, and diagrammatic sketches. It is necessary that a boy should visualize the practical work he intends to do, and be able to show it on paper in two dimensions. The object-drawing that is part of the art course of any school, whether it be done in pencil, or pastel, or water colour, is of great help in this respect. It trains boys to draw, in perspective, simple objects.

In making *perspective sketches*, simple points to note are that all vertical lines remain vertical. Horizontal lines are changed in direction unless they lie in the eye level, when they remain horizontal. All similar parts of an object that are farther from the eye appear diminished in size.

In making *diagrammatic sketches*, the outlines of orthographic projection are followed. The drawing is made to show one or all of front elevation, end elevation, and plan. It is drawn freehand, or with the aid of the ruler in drawing straight lines.

The arrow heads and the figures must be clear and strongly marked. The outlines of the object should be very distinct. The object may be drawn lightly in the first place, in fact, it is better that it should be so drawn; the final line should be strong, but not thick. Often this may be looked upon as the working drawing; and no further scale drawing is necessary. The teacher must exercise his judgment in respect of the boys to whom this should apply, and the kind of work also.

Good lettering is essential, even if the drawing be of a somewhat temporary nature. There is often a reason for a drawing being quickly done; but never a reason for one that is badly and carelessly done. A question may arise as to where these sketches may be made and kept. A good plan is to have a sketch book in which all preliminary sketches are made—the sketches, for example, a boy makes to show his teacher what is in his mind. Each drawing should be dated, the name of the object put down, and the drawing fully dimensioned. It is then discussed with the teacher, and corrections made before the subsequent scale drawing is undertaken.

Scale Drawings.—These usually take one of three forms: (*a*) orthographic projection, (*b*) oblique projection, or (*c*) isometric projection.

ORTHOGRAPHIC PROJECTION.—The most useful of these is orthographic projection. In this form the lines of projection are at right angles to the plane of projection.

The scale.—This we must consider first. Usually the paper used is ⅛ imperial or ¼ imperial; the former is quite good for most preliminary work, and can be packed into a small space, or can easily be put into a wallet. The ⅛ imperial sheet is 11 in. by 7½ in. The object may be drawn full size. In any case, it is a good general rule that all objects should be drawn as large as the paper will allow. If the object is of large dimensions (say a chair), then it is better to make a drawing of it to the nearest scale, and make full-size detail drawings of its parts, the methods of joining them, and the shapes needed.

The ground line.—After the scale has been decided, it is necessary to consider the positions of the various views. To do this we must determine the position of the ground line—sometimes known as the XY line; it is well, however, to make nomenclature as simple and as indicative as possible. The words "ground line" convey the meaning clearly, and are readily understood. The line represents the plane on which an object stands. If the object is tall, as, for example, a palm stand, the ground line will be nearer the lower edge of the paper. If the object is thin and wide, as with a bread board, then the ground line will be comparatively high on the paper. A good margin should be shown; the general effect is enhanced by a satisfactory balance between the margin and object.

The quality of line.—It is better to use as few types of line as possible. To get the best quality of line a sharp pencil is necessary, and this pencil must always be kept sharp. In lining out, the greatest difficulty is to preserve a uniform line. The quality of a drawing depends largely on this. The line should be thin, yet black; there should be no knots; all lines should be the same thickness; a difference in line shows readily, and spoils the quality of the drawing; grey and woolly lines are to be avoided. The drawing should look clean cut and crisp.

Lettering.—This is important because of the general appearance and the descriptive value that is involved. The following items should appear on a drawing: (*a*) The boy's name, (*b*) the name of the object, (*c*) the date, (*d*) the scale, (*e*) the list of materials, (*f*) the elevations and plan and sections. The school and the boy's form may also appear.

All these give opportunity for good lettering. Script lettering is neat, and of good appearance. Block lettering is attractive also. Both these have the advantage of legibility. If boys are found who cannot do either well, let them fall back upon ordinary writing, well done.

The elevations and plans.—It is not necessary, at an early stage, to go very fully into the matter of planes of projection. This is somewhat difficult, and can be understood more easily by older children. It is better, at the beginning to show younger children what in any object are the different views necessary to show its various parts and sizes. Thus a top view gives us the plan; a front view, the front elevation; a side or end view, the side or the end elevation. These may be shown, and sketched, at first, without any reference to the various planes. They are, to the child, simply views. Then they can be shown in relation to each other, and in the places indicated by the projection lines, showing that they are the three views of one object. It is good practice to get children to sketch these from a real object, getting thus a diagrammatic sketch. Then they can visualize a new object, and put it down by means of diagrammatic sketches. This is a good introduction to the orthographic projection of an object drawn to scale. The usual practice with regard to the places of the various elevations is shown in the drawings. Usually the front elevation is shown to the left, and the end, or side, elevation to the right, whilst the plan is generally placed below the front elevation. There is no orthodoxy in this respect, however, and there are various positions in which all these parts may appear that are perfectly correct, and are the result of proper projection. Sections are usually denoted by light parallel lines drawn at an angle of 45°.

The cutting list.—This is a necessary part of a sheet of drawing. It shows the number of pieces of wood required, and the sizes of each. The usual method of ascertaining these is to measure the exact size from the drawing, then add ½ in. to the length of each, ¼ in. to the width, and ⅛ in. to the thickness. This allows for the working of each piece to its exact size, by the plane, saw, chisel, or other tool.

OBLIQUE PROJECTION.—Although orthographic projection provides the best form of representation, yet sometimes children understand a pictorial form better than a flat diagrammatic drawing. Oblique projection is such a form. The object is shown in its three dimensions by one drawing instead of three. The front elevation is shown in its true proportion and shape. The end elevation and plan are distorted in respect of shape, but hold good in respect of size. The whole of the drawing is made to scale and, consequently, each of its parts can be measured accurately. It has been felt that oblique projection is clumsy, and it is certainly misleading in appearance; it gives a wrong conception of proportion, of relative sizes, and of shape.

ISOMETRIC PROJECTION.—A pictorial view of an object that approaches much more nearly to a true perspective, and gives, therefore, a more accurate representation of the object, is supplied by the method of isometric projection. It is really better to think of it as conventional isometric projection. True isometric projection needs an isometric scale, which it is not advisable to introduce into schools. It is enough to use the usual ordinary scales.

Isometric projection has some advantages. The three views of an object are shown in one drawing, and all are drawn to scale. All horizontal and vertical lines are true to size, and can be measured accurately. The whole drawing gives a near approach to actuality and is more explanatory to some minds than drawings in orthographic projection. There are some disadvantages. Diagonal lines, shaped edges, and curves are distorted and do not give accurate measurements. The shapes presented are not true shapes, because the drawing is not in true perspective. The lines not converging and the measurements not diminishing with distance, the appearance of the object on the drawing suggests that it is larger at the back. It is so far an attractive form of drawing that it gives satisfaction to a boy.

It will be found that most objects can be contained inside a rectangular block, and it is well to conceive them as being so contained. A rectangular block drawn in isometric projection provides lines from which measurements may be taken for a reduced scale; points may also be obtained to determine non-rectangular shapes which are all distorted.

The Best Types of Drawing for Handicraft.—In considering the various types of drawing, and their applicability to handicraft purposes, we must bear in mind that they are guides to the making of an object. They act as a " try out " for size, and shape, and proportion. They should be accurate, legible, easily understood, and fully descriptive without being confusing. If a drawing conforms to these requirements, it matters little what type of drawing is used. Long experience, however, suggests that the following sequence will meet most requirements that arise in a handicraft room: (1) the preliminary dimensioned sketch; and (2) an orthographic projection to scale.

The other types can be used on occasion. Oblique and isometric drawings are not, as a rule, met with in industrial drawing practice.

The Use of Drawing Boards and T Squares.—Practice in respect of this varies. It is argued that children should be taught on their introduction to the handicraft room to practise the methods that will be employed ultimately, so that they early become conversant with them. Others argue that children of eleven are not, speaking generally, capable of manipulating the T square, set squares, and drawing board, and that a simpler method is preferable; that, in fact, a ruler and set square are all that are required. Much depends upon circumstances, and the type of child. In any case, however, the latter practice should not prevail for longer than the first year. At the age of twelve a normal boy should not find great difficulty in using the regular tools for practical drawing.

Blue Prints.—The practice of reproducing drawings by this means has been developed considerably in some schools. Many teachers have, in the past, used blue prints made by themselves, from which boys have worked the examples drawn. This practice has now extended to the making of blue prints by the boys. It is well to consider what is the purpose of a blue print in such a case. When the pencil drawing of an object has been made, no other direction is required for making the object. Blue prints are, therefore, unnecessary for this purpose, and are, in fact, a needless duplication. They may be used for the prescribed work of other classes, or for exhibition purposes, or purely as a form of training; but in the making of any object, in the ordinary course, no necessity exists for them. There is, however, a considerable training in the making of such a print. The original drawing must be accurate and clean; pen and ink work is introduced, and this again must be well done; much judgment is called for. It is also a common industrial practice, and as we are keeping children out of industry for a further year, we must try to make this extra year contribute to industry more than it loses.

Blue prints can be used to form a reference library of drawings for future use, and blue prints of joints and tool operations may be kept in the same way.

Grain Lines.—At one time all drawings were grained, but it is not now considered necessary to do this. There was a certain attractivenes that was really meretricious, but often confusing. One saw more " grain " than " drawing ". It is an advantage to show end grain, but no other.

Original Work.—The extent to which a boy should be allowed to suggest his own work is a matter that has been much debated. In the earlier days of the movement, influenced by the " Sloyd " and the " technical " aspects of practical work, no departure of any kind was allowed. Then came the time when alternative " models " were allowed to be substituted for definite models in the course, but containing the same tool operations. Then certain joints were demonstrated, and models were asked for which embodied these joints. After a time the end in view was again changed; the object itself and not the tool operations held the centre of the field. This gave to the schemes a new meaning.

Now, it is possible for each boy to suggest what best fits the needs of his particular environment. These needs vary and so we get a varied scheme. The succession of tool operations is changed; but all that are necessary can be included. To ensure that this is so, it is necessary that the teacher shall suggest some of the work, even in the later years of a boy's handicraft life. When the preliminary training section of the course which all boys will do is completed, the following plan may be adopted; it is suggested with confidence, since it has answered well in actual practice: (*a*) prescribed work in which the teacher embodies what he considers to be the fundamentals, and (*b*) work suggested by the boy.

The actual practice of industry is that objects are made from drawings supplied. Each boy should, therefore, be expected to read other people's drawings. This is one reason why prescribed work is necessary. Another reason is that it ensures a definite training in technique. It is possible that a boy's suggestions may neglect certain phases of technical work that he should adopt. Prescribed work makes sure that he gets it.

The Boy's Design.—If a boy is allowed to suggest his own work, he should be expected to design it. Design begins with planning the parts and the proportions of the object. The purpose of the latter determines the shape and size. Thus a knife box depends, for its size and the planning of its parts, on the objects which it is intended to hold. The size and number of the knives, spoons, and forks determine its length, width, depth, and divisions. After this follows the applied design, if any. If only because of the training there is in it, a boy should be encouraged to make his own design. It should not be forgotten that the teacher should guide and supervise, but the initiative should come from the boy.

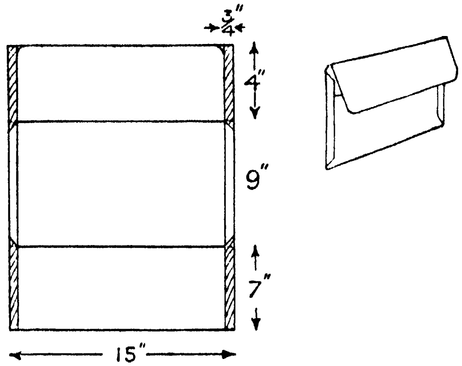


Fig. 7.—Wallet

Storage of Drawings.—A wallet is the best receptacle for these. Some instructors have used drawing books only, but these cannot be arranged for use with T square and drawing board. For the latter separate sheets are necessary. From one sheet of double crown manila paper (30 in. by 20 in.), two wallets can be made. The illustration in fig. 7 shows the sizes and method of cutting. There are other forms of wallet, but this is quite simple and has stood the test of use.

CHAPTER X

The Influence of Art on Handicraft

One of the most satisfactory features of modern handicraft is the extent to which art has been applied to, and incorporated with, its expression. Fitness for purpose is the first law of design, and it is a happy state of affairs that this conception now enters into the creation of the units of the handicraft scheme. After the planning for purpose comes suitable ornament, if called for. This raises the question of the relationship existing between handicraft and art.

Ideally, the handicraft teacher should be a craftsman in the full sense of the word. It has already been said that craftsmanship must include not only the power to execute, but to conceive. The production of an article of use begins with its conception, and the true craftsman is one who produces the article from its very commencement. This power is now happily becoming more and more the possession of the normal handicraft teacher.

The still more happy result is that the work done in the handicraft room is more and more endowed with sound design, in both planning and ornament. In cases like this, there is no need to call upon the art room of the school for co-ordination in this particular respect. There should, of course, always be co-ordination, inasmuch as the training of children in design in the art room should have in mind the necessity for applying their design to the work they will do in both workshops, as well as in the internal handicraft done in school. Indeed much of the latter is a direct outcome of, or at least has a very close association with, the art room. When, however, the handicraft teacher has no feeling for art or training in it, it is well that the children prepare whatever ornamentation is needed for the handicraft in the art room. It is an ideal arrangement if the school is of such a convenient size that one teacher can take both the handicraft and the art of the school, and is qualified to do so. There is then the possibility of a perfect co-ordination.

Right Ornament.—It is most desirable that such legitimate forms of ornamentation as wood carving, repoussé, inlay, wood staining, and painting should be encouraged. Restraint in their use is essential, and it must always be remembered that no ornamentation should interfere with the utility of the object. Always, too, it should be noted that ornamentation waits upon construction. It is the utility need that first arises, the constructional necessity follows, and the ornamental possibility last of all. In recent years this love of ornament (which is a right and a perfectly sound tendency) has brought about various methods which are of doubtful value.

One of these which has had a wide vogue is that form of metalwork which uses pewter, brass, and copper of foil-like thickness. This is a form which should be avoided. The metal is so thin that it needs support by other materials. It is not strong enough in itself to give support or strength to the materials to which it is fixed. It is parasitical in its nature. It gives an appearance which is misleading.

Another kind of ornament that is of doubtful value is sealing-wax decoration. This does not beautify wood; at the best it simply hides it and at the worst makes it ugly. Wood is not a material that need be hidden; even plain wood has beauty. We can agree that for some practical purposes it can be stained, or even painted. Sealing-wax, however, is incongruous in association with wood.

Wood Carving.—This kind of ornament has the sanction of history and tradition. It is responsible for some of the highest flights of imagination of craftsmen. Some of these exceed the limits to which we should go. The law of materials indicates, and in fact dictates, how far we should go in the character of the carving. Low relief, little " ground work ", and a respect for the material are called for. Chip and surface carving belong to the childhood of the world, and perhaps, therefore, are suitable to the children.

Chip Carving.—This form of carving has, as its basis, a sunk triangular pocket. This, by repetition, and alteration of size and proportion, can be used to produce an effect that, although not, perhaps, great art, satisfies a child's desire for decoration and which is, at the same time, not unattractive. It has one advantage in the teaching of design. It emphasizes the value of repetition. It has been said that design *is* repetition. Although this is not the whole truth, yet it is so far the truth as regards pattern, and is so far true in respect of the design of which children are capable, that it can be accepted as a good guide. Children can build with simple units the very best of pattern. One advantage of chip carving is that the pockets, which are the units of design, are not wide and do not take away from the use of the surfaces that are carved. Thus horizontal surfaces such as one gets in stools and trays are not thereby rendered useless for the purpose for which the articles are planned.

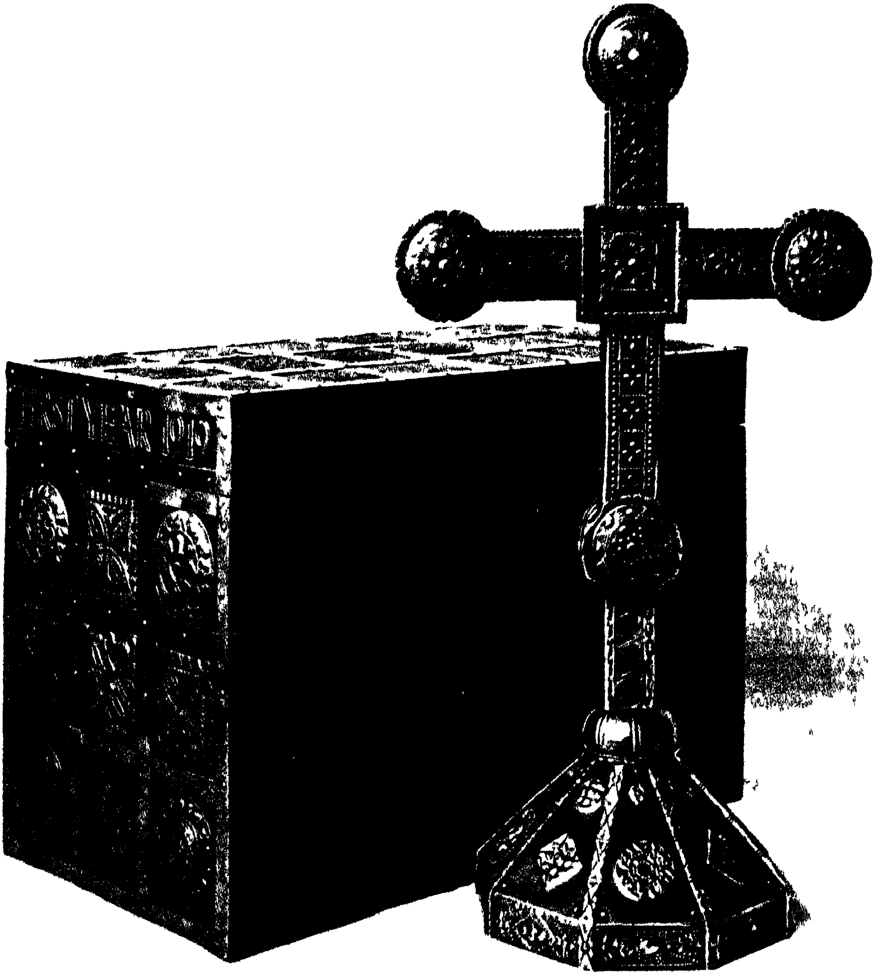
Surface Carving.—Much work other than chip carving can be done in what may be termed surface carving. This consists in cutting the surface only; there is no ground and no relief. Lines are cut, and between them whatever modelling is considered necessary is done. Much of the work is again done on the lines of pattern. It is effective and quite legitimate. It does not interfere with the due purpose for which the work was planned.

Relief Carving.—It may not be possible to get many boys who are advanced enough to tackle relief carving. Yet undoubtedly we have children, both boys and girls, to whom relief carving will be a suitable outlet for their impulse towards art expression. This number will increase as we begin to feel the benefit of the higher leaving age, for so many children will then have had the benefit of continuous instruction in art and handicraft from their entrance into the junior school.

The question will arise: what kind of design shall we include as suitable for the work we intend children to do? All applied ornament must be connected with some form of construction. The planning of the course advocated for seniors includes the making of furniture. The articles made must fit a purpose, and this purpose will be modern in character. Therefore our wood-carving design will be modern also. It will be understood that the children will make their designs as part of their training. It will in all probability be found desirable that these shall be done in the time set apart for art. Wood-carving should always be done in wood that is suitable; oak, walnut, mahogany, sycamore, birch, beech, are suitable, and satin walnut and Canary wood also.

Wood Sculpture.—This is a decided possibility. The carving of animals, even if only for a Noah's ark, is of the most absorbing interest. Umbrella and walking-stick handles, letter weights, finials, knobs on umbrella stands, door handles, ends of chair arms, book ends, candlesticks, offer a satisfactory field for this work.

Repoussé.—The desirability of repoussé is so great that it may be introduced as a special intensive course. Some boys have a leaning towards the art side of handicraft. Repoussé will satisfy this desire. There is the planning of the work. This will be done from existing specimens, or pictures of good work, in the first place. Following this comes the selection of materials, and their due preparation. Then comes the shaping



By courtesy of the Director, Central School of Arts and Crafts, Birmingham

GROUP WORK

Exercises in repoussé work, the use of punches and files Individual inventions by pupils of a class are here assembled to cover a wooden box and a wooden cross The diversity of pattern is unified by similarity of treatment and size, and prompted by the tools used

of the metal, and its ornamentation. This needs sound judgment, continued watchfulness, economy of effort, sureness of touch, and artistic outlook, and a sure instinct or feeling for taste. If such a course be devised, it can be taken continuously for one or two terms intensively, or it can be spread over the entire metalwork course, and the objects taken at intervals as part of the work of the whole scheme.

Wood Staining.—The practice of giving a finish to the work done in the handicraft room is increasing. One method is that of staining the wood. This can be done plain, or in pattern.

Opinions differ on the desirability of staining wood. It is said that it is an act of vandalism to destroy the appearance of a wood surface of beautiful grain and texture. This is so largely a matter of individual taste that the issue must be left for each one. What is certain and dependable is that no treatment of surface should, at any time, destroy the usefulness of the object. Neither should the stain be used merely to imitate an appearance that is the result of natural forces. If the staining and painting do not do these things, then the treatment is a matter of taste, and will be decided personally.

Wood Painting.—This is usually done with tempera (body) colours. In this case the wood is completely covered with paint, or, at least, that part that constitutes the pattern. It is then varnished to fix the paint, and to keep the object clean. Sometimes oil paints are applied by stencilling.

The Finish.—In those days when the purpose to be achieved in a woodwork scheme was training in tool operations and general technique, no object was finished in the sense that the material was protected from the consequences of use. All articles were finished " in the white ". Now that the objects in a scheme are made for use, this contact with reality makes it imperative that a finish shall be given that will withstand the use for which the object was intended. Thus furniture should be polished in some way. This may take the form of French polish, or a simple wax polish. Sometimes the object should be stained, as a matter of taste, or painted to withstand weather conditions, as a bee-hive, for example; or treated with a preservative as in the case of a garden hut or a hen-house.

The same general rule is followed for metalwork. Some metal objects are finished by heating, and then dipping in linseed oil and burning off. Others are blacked with Berlin black, or coloured with acids.

The rule to be followed is that any object should have a finish that is dictated by the use to which it may be put. With regard to wood, a wax or oil finish is preferable to French polish and varnish. It is more natural, and less ostentatious, and certainly more tasteful. The desire for a stained article is not altogether sound; it has led us very far away from an appreciation of the beauty of the natural colour and grain of wood. The desire, however, for a satisfactory finish is good. The article being made should be conceived in a complete sense. It is intended for use, and should therefore receive the same treatment that it would do if it were being dealt with by a trade craftsman.

There is another sense in which the word " finish " can be used. This concerns the condition of the surface that is necessary for the object, after the tool work has been done, and, incidentally, the methods that should operate in getting this required surface. It must be said, quite frankly, that the edge tools are intended for shaping and working the wood. Sharp tools in skilful hands should provide all the finish that is desirable for most objects made in wood. For metal, the use of files and emery cloth is legitimate, because these are natural metal-working tools. For wood, however, files and glass-paper should be used sparingly. It is a good working rule to bar their use during the first year, and introduce their use later when the boy has achieved some skill and judgment in the use of the edge tools. For wood, the skilful craftsman can get a satisfactory finish by the use of the smoothing plane for flat surfaces, and of a sharp chisel and spokeshave for curved edges.

If the work has to be French polished, a scraper and glass-paper for flat surfaces, and files and glass-paper for curved edges, are necessary in addition. There is a real training in the use of files and glass-paper. Their use has, however, been very much overdone. The ease with which a file can reduce the rough curved edge that is left from the bow saw, compared with the more patient work required to obtain a similar result by the use of a chisel, is a temptation that is rarely resisted. It can be said that a boy who has not learned to make a satisfactory finish with a smoothing plane has not reached that development he should have done, and, moreover, he will not be able to obtain the finish required with the files and glass-paper unless he has acquired some degree of skill in the use of the edge tools. The greatest restraint is called for in the use of scrapers, files, and glass-paper. In any case we must see that when they are used they constitute a real and a definite training, and are used with an eye to this end.

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ART

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ART

CHAPTER I

Introduction

There are two ways of approach to the teaching of drawing, one by way of interest and feeling, and another by way of technical exercises. Although what follows will deal mainly with exercises for developing skill, it must not be forgotten that skill is not the essence of art. And because it is easier to set exercises in draughtsmanship that evoke those enthusiasms and preferences which may express themselves in works of art, it is the more necessary to keep freshly sensitive to all forms of loveliness so that lessons shall stimulate interest and quicken love and enthusiasm for beautiful things. Such enthusiasms are contagious. Example and evidence of genuine pleasure in beauty can be an effective leaven when technical knowledge and art lessons are of no avail. " We live by admiration, hope, and love." Learning is too often dissociated from liking. In lessons on art such dissociation is fatal to success. A child's bored protest: " We've done these horrid buds for years," showed that even spring's budding loveliness had been made a weariness. All good drawing is interested drawing. Too often the subject-matter of a lesson, or its presentation, precludes interest.

The aims of the art lesson may be said to be: the development of the faculty of seeing to its highest sensitiveness so that nature's infinite loveliness and the artist's work may be enjoyed; the training of the visual memory, invention, and imagination, and the storing of the " inward eye " with all forms of beauty; the development of draughtsmanship, painting, and skill in the simple arts and crafts as means of expression and for creative work. These are mentioned in something like the order of their importance for the average child at school. The history of the teaching of drawing in the nineteenth century, however, shows more than a reversal of this order, for early lessons in drawing were confined either to the reproduction of mechanical and formal diagrams, or to learning some tricks of style and handling which put specious finish and copying before individual seeing or personal expression. Some little skill in drawing is still too often the only aim of the lesson in art.

Self-training

With school duties filling each day, little time is left for a teacher's own practice. Yet unless time is found for personal work, teaching inevitably suffers. The difference between the work of a class taught by a teacher who continues self-training and that of a class taught by one whose practice and taste ceased to be exercised when official qualification was obtained, is immediately noticeable. One shows life, the other stagnation. An art teacher must be able to show by sympathetic example; and the skill and temper necessary for this cannot exist unless creative ability and discriminating taste are kept alive and active. No enthusiasms for wider and worthier admirations are stirred where the teacher feels none. Though an art teacher's practice is never done, the hours given to it bring unalloyed pleasure, and lead by many ways to beauty in many forms. Some teachers may choose to practise one of the crafts on which some suggestions are given below. Other suitable crafts (their number is limited by considerations of equipment and space) are light metal work, silversmith's work, jewellery, enamelling, and cabinet-making. The designing and making of costumes and accessories of dress for plays involves several crafts, and leads to excursions into heraldry and into history, for which the following books will be found of great interest: Barnard, *Companion to English History*; Breasted, *A History of the Early World, Ancient Times*; Robinson, *A History of the Mediæval Period.*

Those whose interests lean towards drawing and painting will find pleasure and profit in drawing plants and flowers; and an album of studies, which may be added to constantly, may be a record of discoveries of fresh and lovely things. The illustrations to Gerard's *Herbal* indicate one way of making drawings. These studies may subserve other interests: be material for design, as for embroidery, or studies for colour schemes. Some may make a collection of portraits in pencil or chalk, and, while improving their own draughtsmanship and power of expression, increase their enjoyment of the best—the drawings by Holbein, Dürer, Leonardo, Ingres, the early miniaturists and the finest artists of to-day. Portrait drawings can be made anywhere and at any time. Other teachers will find in architecture a fruitful field for study. There are few towns or districts which have no buildings worth drawing, and, if the humbler kinds of traditional building be included, there is often a fairly complete sequence of examples from Norman times to the end of the eighteenth century. The artistic value of these buildings, as distinct from their archæological value, should be stressed. It is desirable that careful drawings be made, and any building which can be the subject of argument between educated people is worth study. Joinery, metal work, or other architectural crafts may also be dealt with. *The Development of English Building Construction* by C. F. Innocent,[1] *The Practical Exemplar of Architecture*,[2] and the architectural drawings of Edmund New (see his Loggan prints of Oxford, and his illustrations to White's *Natural History of Selborne*), indicate ways in which study will be profitable. In association with the study of a wide range of arts and crafts, it is well to draw an historical chart and to make this serve as a table of arts and crafts, entering on it works which have been studied.

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[1] Cambridge University Press. [2] Architectural Press.

Collections of Exemplars

A teacher of art should know and be able to enjoy the outstandingly beautiful things which artists and craftsmen have made. As exemplars of good draughtsmanship there should be available prints and photographs of drawings by Dürer, Da Vinci, Pisanello, Rembrandt, Augustus John, Sir William Orpen, and others. Drawings made by primitive draughtsmen, in which interest and sincerity rather than accomplishment and power are outstanding qualities, should be studied. The work of Giotto, the drawings of animals by Pisanello, the early drawings of Dürer, and, in another direction, drawings by prehistoric man show these qualities. The drawings of craftwork by William Twopenny and drawings of birds by Bewick show the same qualities in other directions. Among the publications, prints, and photographs issued by the British Museum, Victoria and Albert Museum, and the Ashmolean, much useful material will be found. This material is among the cheapest and best available, and it covers a wide range: drawing, painting, sculpture, carving, weaving, costume, embroidery, woodwork and furniture, small metal-work, printing, bookbinding, writing, pottery, and other crafts. Any well-illustrated books on peasant art should be obtained, for these show where unpremeditated art enriches simple things which serve ordinary human needs and interests.

A school which does not possess a collection of such exemplars is ill equipped, and an art teacher must be as familiar with the best of them as a teacher of English is with the landmarks of literature. The best in the form of lantern slides or reproductions should be at hand for inspiration and enjoyment as the best poetry and the best music find their place in school. A series of charts of arts and crafts should be put where they may be referred to: the inside of a cupboard door is a convenient place. " Models " made as exemplars should be avoided. Where they are not ugly they are deadly dull. A teacher's own interest, continual training, and enjoyment of the widest range of beautiful things are of prime importance.

It may be said that the drawings referred to are so outstanding as to be beyond the comprehension and out of the reach of children. That is not so. They have the qualities which children enjoy, and point a way to good draughtsmanship along which children can be happily led and stimulated. No knowledge of advanced art criticism, or subtle appreciation, is necessary to see the artless and unaffected sincerity of drawings by men like Giotto or Pisanello. It is the spirit in which the work is done, of loving interest and curiosity, which matters. The drawings by children will be made in the same spirit if their efforts are well directed. A superficial mannerism is too often suggested or approved. Such mannerisms were deliberately taught in the old drawing-books, and those teachers who could " form the style of a pupil " completely on their own style were considered successful. But innumerable Raphaels minor are not wanted. With insensitive teaching a whole class will produce drawings as nearly alike as may be, aping a style preferred by a teacher or one picked up from some popular illustrator or advertisement.

To form the style of pupils in this sense is little less than mind murdering, and cannot be too strongly condemned. Every teacher must be continually on the alert to prevent this happening. Ugly and meaningless mannerisms will appear no matter how good the teacher is, for children naturally imitate a noticeable trick of style, or superficial smartness, and so make drawings which are quite unchildlike. A child's drawing should look childlike. Too often evidence of power, accomplishment, or finish are looked for instead of tender and naïf beginnings which, in spite of faults of technique, show keen interest and effort. Instead of drawings all to one, even excellent, pattern, the work of a class should be as diverse as the children in it. As teachers we cannot describe precisely the drawing to be made, but when it is made we should recognize it by marks of personal preference and sincerity. To be able to recognize, and sympathetically appraise, such new-found expression is a teacher's most difficult task. So it is necessary to be reminded continually of those qualities which are seen in drawings by early masters, and have many examples of good drawing handy for reference and study. The search for a selection of such exemplars is in itself a lesson in taste, and it would be well to develop the selective instinct into a habit. For the number of beautiful things is infinite and the continued exercise of carefully considered choice among them is one of the best ways to improve taste. The way in which a lesson is set, its subject, the size of the exercise to be done and the materials to be used, often impose a stiffness of mind and uniformity of outlook and expression without the teacher recognizing the causes. Whatever freedom is possible and healthy should be allowed. It may be said that differences do not show in the work of children. The beginnings of what will be adult preferences often show. Be on the look out for them. To make up one's mind beforehand that differences do not occur, or are negligible, is a sure way of overlooking them and ruling all to one pattern.

Just as for appreciation of good music it is necessary for a teacher of music to know good music, hear it often, and, in however modest a measure, have some ability in making music, so it should be with the art teacher. Teachers who know and enjoy good things desire them for themselves and their pupils. It has been said: " Show me an art teacher's home and I will tell you if he is fit to teach art." And because a good teacher is a student also it will be well to suggest some lines of study for those who take either junior or senior school work.

Drawing.—Of exemplars of drawing something has already been said. A list of them should include reproductions of the drawings of Holbein and of the drawings and etchings of Rembrandt; for delineation of architecture and building, reproductions of engravings by Hollar and of drawings by Edmund H. New. Of drawings of flowers and plants it is difficult to find a better selection than those taken from old Herbals which are included in *The Craftsman's Plant Form Book* by R. G. Hatton. A good reference library will usually contain copies of early or later Herbals, among which Gerard's and Parkinson's have the largest number of illustrations. In the same libraries copies of Bewick's *Natural Histories of Birds and Quadrupeds* can be studied. Late editions of these books should be added to a teacher's library if possible. The exemplary drawing and engraving of their many illustrations must always be a standard. And since children will always delight in drawing birds and animals, the work of Bewick, which is among the best of its kind, should be readily accessible. Some Japanese picture books of birds and insects show, in another way and in another medium, similar keen observation and love of the thing drawn. Of birds and animals the Assyrian and Egyptian low reliefs at the British Museum give still other renderings showing the same intense interest. Photographs of these may be obtained at the British Museum. The subtlety and beauty of these are better appreciated by a teacher if drawings are made of them. But for children, a rendering, even though it is as good as these, can rarely have the compelling interest of live birds and animals.

Art Forms in Nature by Karl Blossfeldt and *Plant Form* by Meurer show another side of the beauty of natural form: X-ray photographs of shells open the eyes to wonderful beauty otherwise undreamed of: these make striking lantern slides. *Spirals in Nature and Art* by T. A. Cook, and *Design in Nature* by Pettigrew, though they deal with aspects of nature other than those depicted by the artist, reveal beauty and interest which otherwise might pass unnoticed.

Painting.—Of painting, perhaps the most helpful examples for study will be found among the works of early painters in water colour. These works are simple in treatment and show the value of washes of colour carefully laid, and a nice sense of the limits of water colour. The beauty of these washes of colour—their transparency, their sure manipulation and delicate gradation—asks no merit from accidental effects which may come from using colour carelessly. The interest, detail, or intricacy which may be suggested by accidents in water-colour painting is a pitfall for beginners and amateurs.

Reliance on adventitious handling leads nowhere. It is better to do simple work well than to have questionable satisfaction from a seeming competence which is but lucky accident. Turner is reported to have said that he never lost the advantage of an accident. With this saying Turner's mastery of water-colour technique should be remembered. The sure dexterity of his early work should be studied by all who would use water colour properly. A comparison of the work of early painters in water colour with that done during the last half of the nineteenth century, clearly shows which is the soundest technique for a teacher to follow. The advantages of a limited number of good colours and of suitable paper also show in the early work. Limitations in the number of colours and a simple if exacting technique are advantages, for with them it is necessary to select carefully the aspect or characteristic we would show and to decide how it can be rendered before beginning to paint.

Modelling and Carving.—Modelling and carving are often taught in the same room by one person, but association of the two crafts should not confuse their essential differences. The things to be expressed, materials, and methods of expression are different in each. Perhaps the differences and characteristics proper to the two crafts may be seen best for the present purpose, being within the range of children's interests, by comparing a carved wooden toy from a good Noah's Ark such as come from German peasant workshops, a king or knight in walrus ivory from the Norse chessmen at the British Museum, with modelled toy figures and animals to be seen in the Greek Room there (picture postcards can be obtained of both these). If reference cannot be made to these, comparison of carving with modelling may be made between the Noah's Ark toy and a dog or figure of old Staffordshire ware.

Even though a teacher's work and that of children be but elementary and rise to but a very modest level, a teacher should appreciate the essential differences between modelling and carving so that subjects for each may be well chosen. Modelling should look plastic, moulded, kneaded into shape. The modeller makes play with the soft roundnesses of forms, complicated shapes are built up with added soft material. Contrariwise, because carved forms are made by cutting material away, a carver looks for planes and flatnesses which will express the shape desired and be the direct outcome of cutting. Evidence of plasticity and building up in modelling, and of tool cuts in carving, help the expressiveness of the respective crafts if the work has been well and directly done. But by cutting with hard tools the characteristic qualities of plastic work are often sacrificed for a superficial appearance of carving, and, with a liberal use of sandpaper, files, and riflers (though these may obliterate incompetence), the characteristic cutting and life of carving is changed for a smug smoothness. As exemplars the Assyrian and Egyptian reliefs of animals and birds mentioned above, and mediæval carving also, show what may be done. Interest and craftsmanship are duly balanced. For beginners it is well to avoid examples in which style and consummate ability are outstanding. If it may be so put, the matter should be better than the manner. Craftsmanship follows interest, but prompts invention and expression. So the work of artists and craftsmen who worked at the beginning of a period rather than the work of those at the end of it, offers most to beginners. The style of a Michael Angelo is out of reach, inimitable, the end of its kind. Peasant art of any kind is, for these reasons, fuller of suggestion and inspiration, being nearer to children's interests and abilities.

Design.—Design is often poorly taught. It may be said that it cannot be taught apart from actual making. What is the design for? brings up at once problems of fitness for purpose, materials, and processes. Without knowledge of these, and some faculty in co-ordinating their various requirements, good design is not possible. Drawing and craft should be co-ordinated and exercises planned to complement and enrich experience gained in either class. If interdependence of the drawing and craft classes were the rule, unpractical paper designs would not so often be made. For, contrary to general belief, it is more difficult for a child to make a good design on paper than to make one in a material. Practice and experience must come before drawings suggesting how and what to do. The making of designs on paper for various crafts and processes of the technique of which a child can know nothing, should be avoided. There may sometimes be a reason outside this argument why they should be attempted. Many difficult crafts for which exercises in design are set cannot be within the compass of the tyro; many years of full-time apprenticeship must be given to acquire them. A child is led astray by being set to make, say, a design for a stained-glass window or a tapestry with figures. Yet when these and many other attractive but impossibly difficult projects are ruled out, there will still remain much profitable work to do in drawing, colour work, and design, exercises which stimulate invention and resourcefulness in direct relation to crafts with which a child may have practical experience. A teacher will probably specialize in one craft and have a working knowledge of other simple crafts, and these will be found to refresh the daily teaching as nothing else can. To help such practice the finest standards will be studied and enjoyed, and the pleasure and profit derived from them will also be shared in the classroom. A knowledge of the very beautiful baskets of varied design and materials made by Japanese, North American Indians, and other races shows to what perfection basket-making may be brought. It is no exaggeration to say that the best of the baskets recall the refinement and beauty of Greek art. Admirable also, and perfect of their kind, are the " swills ", shallow baskets of split wood, and those woven of halved oak branches which are made in the Lake District. A collection of such baskets, of great variety in shape, weave, and material, would not be expensive or difficult to form, and it would be of great service for reference and inspiration. It would show, among other things, that the best baskets are those made for definite purposes and hard use, and the worst, both in shape and workmanship, those made for ornament.

Such collections are to stand to their respective arts or crafts as anthologies or good libraries do to literature. The exemplars may have historical, ethnographical, or geographical interest, but their real purpose must not be subordinated to these or their beauty and craft interest will be forgotten. Archæology may be mistaken for art; it often is. So museums of art and craft, by following diverse aims, confuse the seeker after beauty.

Bookbinding.—Illustrations of the craft of bookbinding in its many delightful ways have often been published, and good text-books show in detail methods of binding. Examples of plain work beautifully executed may be purchased, and illustrations of a range of styles, English and foreign, may be found in inexpensive prints and photographs. The ways in which decorative treatment grew out of construction in early bindings should be especially noticed, for neat and graceful finish, added to necessary construction and well-chosen materials, always looks well. And since elaborate work is rarely possible, or desirable, in school classes, the intrinsic beauty of carefully finished and nicely considered simple designs should be illustrated and commended whenever possible. The work of those who are responsible for the present renaissance of this craft in England, T. J. Cobden-Sanderson and his followers, Douglas Cockerell and others, should also be studied for the soundness and beauty of its workmanship. These English bindings may be compared with modern French bindings in which the limitations of the craft are violated.

Leather-work.—The craft of leather-work as practised in schools is unduly restricted in style and treatment. In this, and in other crafts, price of materials limits scope. The craft is a comparatively new course in schools. Teachers with wide knowledge and experience of it are scarce, and examples showing varied use and treatment of leather (such as may be found in articles from Nigeria, Hungary, Morocco, Turkey, Spain, or Russia, countries known for good leather-work) are rarely available for reference and inspiration. It is not suggested that such examples should be copied, but that they would suggest a wider range of appropriate uses and variations from work now practised, give scope for invention, and prompt imagination along new ways.

Linoleum and Wood-block Cutting.—With linoleum and wood-block cutting, as with other crafts, it is necessary to stress the qualities and characteristics which each material can best give. Comparatively soft linoleum, in which the cutting of clean and fine lines presents difficulties, and in which, from its granular composition, small detail is likely to crumble and break, suggests patterns and subjects having simple areas with relatively small spaces of ground cut away. It is comparatively difficult to cut fine linear detail in linoleum, and if it is cut it does not stand much printing. On the other hand, the close and hard texture of a boxwood block suits delicate detail, precise forms, and fine lines. Cherrywood blocks, used for colour-block printing in the Japanese manner, serve a technique between these two, as the blocks used are between them in hardness and compactness of texture. Practice with these three kinds of blocks should be supplemented by making a collection of prints which show work done felicitously within the limitations which the three materials propose—suitable in style of design and type of subject. Little children will succeed best with simple patterns and simple subjects in linoleum. The differences between white-line work, in which the subject is given by white lines and spaces cut away, and work in which the subject is given by dark lines and shapes left from which the ground, or voids, have been cut away, and of mixtures of the two methods, should be studied.

It will be seen that the different methods give differing effects, and that white-line work is most suitable for beginners. In its simplest expression it may take the form of patterns incised on a ground. Among things which may be referred to as exemplars, the following may be cited: the work of Bewick, Calvert, Samuel Palmer, and of Italian wood engravers of the last half of the fifteenth century. The revival of wood engraving and wood-block colour printing in our day has been well shown in various publications. Permanent exhibitions of examples are shown at the Victoria and Albert and British Museums. Among much that is good the work of E. F. Daglish should be studied for the present purpose. Japanese colour prints show other qualities and styles. The forms of heraldry provide both simple and difficult exercises particularly suitable for use in these media.

Pottery.—The cost of some crafts restricts or prohibits their use in schools, and practical difficulties prevent the introduction of others. Pottery is one of these, but where it can be introduced it gives valuable opportunities for education in design, form, colour, and pattern. It has been practised all over the world from time immemorial: it illustrates the development of the human race when other evidence fails, and its wares are a continual comment on history. It has added to the world's beauty some of the loveliest things which men have made: materials apparently worthless are changed by the potter into useful and beautiful things. In the practice of making pottery, foresight, skill, and artistic sensitiveness all have place and opportunity. In many countries potters still work in simple ways and by hand processes, and visits should be made to them and their help sought. A collection of peasant pottery and of any traditional wares made locally, or found in local markets, will show forms suitable for clay, suggest right ways of practice and decorative treatments which arise out of the craft. A teacher should see that all pottery which is used at home and in school is good, carefully selected for its serviceableness, beauty of form, colour, and treatment. There should be a drastic weeding out of ugly things, badly designed and poorly made. That pottery and china which is made solely for ornament is usually the most unsightly. To this extent with this craft a teacher can practise what is preached. In keeping all pottery, both for household and school use, up to a good standard, comparable if possible with the beautiful yet homely wares, specimens of which are treasured in the National Museums, taste and knowledge will not remain stationary but grow in appreciation of better things, and this cultivated interest will be reflected in school teaching. There is a present-day renaissance in this craft, and the work of present-day craftsmen and manufacturers who are improving pottery and china should excite lively interest and, with many other things of daily concern which have been mentioned, couple an art teacher's work in school with the wider interests in arts and crafts outside.

Lettering.—Lettering is one of the most useful crafts a teacher can practise. It has numberless uses, little apparatus is needed, and it can be done wherever there is good light and quiet. The development and history of the alphabet are of great interest and their study, though not directly of æsthetic value, leads to careful comparison of forms and styles and selection of those which show the essential qualities of good lettering: readableness, beauty, character. Letters of good proportion and fine form are difficult to make, but the discipline, practice, and familiarity with good examples which are necessary for making good letters are well worth while. A nice appreciation of the beauty of fine lettering is a pretty sure test of taste. Ability in lettering is bound up with fine handwriting, the practice and teaching of which are dealt with elsewhere. Here it will suffice to give some sources of inspiration and exemplars for teachers' use. First among these, Edward Johnston's work should be mentioned, for it is outstanding. What he has written of this craft is authoritative and should be studied carefully. To him, and to his pioneer work, the present revival in lettering owes most. His own writing and lettering is incomparable except among classic examples of the craft. Original pieces of his practical work can rarely be seen, but reproductions of it may be bought and these should be kept at hand for reference. Photographs, the larger the better, of the inscription on the base of the column of Trajan at Rome, and of the Roman inscription found a few years ago at Uriconium (Wroxeter) in Shropshire, should be in every teacher's collection. These two examples are probably the finest pieces of lettering which exist. The Renaissance may be represented by prints of Albert Dürer's alphabet and of one designed by Holbein (used on the title page of Sir Thomas More's *Utopia*, Froben, Basle, 1518), or by a photograph of the inscription on the tomb of the Emperor Henry VII, in the Campo Santo at Pisa. From these many good variants have been derived. At the Victoria and Albert Museum photographs of these and others may be bought, and also a sixpenny picture book of the Roman alphabet. Poor and bad alphabets are produced for teachers' use, and the attractive ways in which they are published often cause the few ultimate exemplars to be overlooked, and the value of pen and chisel as letter-making tools to be forgotten.

For different purposes and positions—for example, a book page to be seen in the hand, and a large poster to be seen at a distance—appropriate weight (that is, thickness of the stems to the height of letters) is important. Roman capitals of the proportion of the Trajan inscription may look thin and poor when used for large painted inscriptions out of doors. The alphabet of block capitals, small letters, and numerals designed by Edward Johnston for the Underground Railway Company is probably the best of this kind, and such block letters are useful when Roman capitals of usual proportions would be indistinct.

The pen is the letter-making tool. A teacher should practise with all kinds of pens, cut square or slanting, of quill, reed, and steel, but avoid pointed steel pens. Brushes will be used for painted work: flat ones with bristles cut square are analogous to square-cut pens. Chisels will be used for work in stone and plaster. Although pens already shaped be used, a teacher should know how to cut pens for various purposes, for that is to know what to ask of them, and why letters are the shapes they are. Good variants in the shapes of letters can only be invented with the letter-making tool, and it will be the tool as much as the craftsman that will make them. In this, as in all other crafts, the tool should be allowed to give character to work which should look inevitable. Tinkering eliminates character, and while it may make letters more " correct " it takes away that spirit, evidence of right endeavour, and look of directness, which are of more moment than exact likeness to a chosen model. This may be seen even in those alphabets which have been made up, and redrawn, from classic examples. To notice by comparison with originals just where their loss of beauty occurs sharpens judgment. Not that lettering should look careless or loose: it is of the essence of it that it should look uniform and have skilled and unaffected boldness.

The encouragement of individuality and personal expression, good in many things, cannot be pressed here, for expression of individuality and personal preferences are made at the risk of readableness and legibility. Such new shapes as can be safely made will always be easily and unconsciously accepted as arising from the norm. Only the very competent can take liberties. So " fancy " alphabets should be avoided. There will always be opportunity for invention and variation in the handling of lettering, in its placing, arrangement, emphasis of parts, colour, and in small embroideries of pattern which in no way interfere with legibility. Though Edward Johnston's book is well known in American schools, encouragement of free expression there leads to deformed and unreadable lettering which is the worse because of a conscious " artyness " which it shows. Some of the uses to which this craft may be put are given later.

CHAPTER II

The Art and Craft Rooms

Room for Drawing and Painting

It has been usual to give one large room to art teaching, but it would be better to have two smaller rooms, one for drawing and painting and another for crafts. The room for drawing and painting might be the larger one because it is possible with these subjects to take a larger class than with crafts. This room should be well lighted from one side, the window-sills being four feet or more above the floor so that shadows from hand and pencil are reduced, and light and shade simplified on objects to be drawn. The windows should ordinarily reach to the ceiling; they may go above it to ensure adequate light on the side opposite to the windows. It is an advantage to have opaque blinds, and they should draw up from the bottom This makes possible various effects of light and shade, and if the vertical edges of the blinds run in grooves, the room may be easily darkened for lantern lessons. The wall at right angles to the windows and opposite to the class when windows are to the left, should have a central space some ten feet square, or the whole wall, prepared for lantern pictures. If this wall be so used, a lesson in drawing, design, or painting may be changed to one with the lantern without moving either furniture or pupils. Along the wall opposite to the windows, cupboards may be arranged for apparatus and models and for keeping pupils' work. The entrance to the room will probably be from this side, and pupils will take their work from here when entering the room or leave it when a lesson is done. There will be room for circulation on this side, for the class will work in the best light towards the windows. The wall under the windows will be kept clear, so that the floor space there may be well used. The cupboards above mentioned may be continued round both ends of the room at the same height as the window-sills, and so ensure an orderly and unified arrangement. The top of the cupboards will be used for the display of a few beautiful things, and on the wall above them one or more pictures will be hung. Uniform in height and appearance with the cupboards, and in a corner of the entrance side of the room, so as to be accessible, there should be a good oblong sink with shelves above for water-pots.

Each pupil will need a chair and some form of easel. The simplest and possibly the cheapest easel is a large steady stool. Against this stool a pupil leans a drawing-board which rests on the knees. Several stools placed together with a covering board over them form a useful table for various crafts. These tables can be made up to different sizes. One of the best pieces of furniture for art-room use is a strong and steady easel-table. The top is adjustable in height, and from being flat it may be sloped to a steep angle and in all positions makes a firm easel. It has arrangements for holding examples for study, materials for painting, space for paper and books. It may be used as an ordinary desk. When not in use it packs closely with others, several form a steady table, and many with boards laid over make a strong platform. A lighter piece of furniture called "the four-ways table easel" has three adjustable slopes and can be used as a table for craft work. Linoleum and wood-block cutting and printing and lettering may be taught in the art room, and some of the converted stools or easel tables above mentioned used for these crafts.

Diffused electric lighting is best for general work, and this may come from one central position. There should be a plug for a light on the teacher's table, which will be in front of or near the lantern picture surface. Furniture and fittings, doors, &c., look best when finished all alike.

Craft Room

This may be lighted on three sides, and since some crafts require a good light close to the work, the tables may be placed under the windows, the sills of which should not be more than a few inches higher than the tables. Gas for soldering should be laid on to these tables. Tables for modelling will be placed at right angles to the windows to ensure a maximum of light and shade on the work of students, who will either sit or stand to them. The tables will be about 6 ft. to 8 ft. long by about 3 ft. wide, and they will have a raised ledge on their long edges. Down the centre there will be a double slope with a flat top, in section like a letter A with the point cut off, and on top of this examples and tools may be placed. Shelves will be fixed in the framing of the table underneath for keeping modelling boards, pupils' work in progress, casts, and tools. Against this double slope pupils will work on both sides of the table. A clay bin lined with lead and having two divisions, one for prepared and another for used clay, will stand in a convenient place. That part of the room given to modelling should be placed where it cannot be used as a passage-way, for waste clay is easily trodden about. Steady tables will be necessary for bookbinding and leather-work. These may be placed at one end of the craft room near a blackboard, where they may be used for occasional lessons which include drawing and drafting. If there is a hand press it should be near by. Water and a sink will be needed for use in all the crafts. Adequate storage room and cupboards will also be necessary for keeping materials, work in progress, tools, and finished work. The sizes and shapes of these cupboards and their places in the room require careful consideration, if the room is to be of maximum service, look orderly, and be easily kept so. Either standing free in the room, or placed under a window, there should be a glass case for the display of a few beautiful specimens of work for inspiration and as exemplars. For the same purpose a few framed photographs or prints showing fine craftsmanship will be hung on the walls. As in the room for drawing and painting, the main artificial light in the craft room will be diffused from the centre of the room. The tables which stand under the windows will have separate lights over them.

Equipment

Art and craft rooms are usually badly equipped. A set of geometrical models, with some vases and pots of poor shape are often the only things provided. Without objects and examples of varied forms, sizes, and colours, the eye cannot be trained to appreciate differences and subtleties, and the problems of draughtsmanship and painting cannot be presented. A good collection of examples will include: (1) fashioned articles, (2) natural objects, (3) prints, photographs, and pictures, (4) books and lantern slides, (5) casts and original examples of art and craft. These stand to the teaching of art as a good library does to the teaching of English.

Fashioned Articles.—Such things as are selected for the collection should be good examples of their kind, however humble their kind may be. They should be well made, fit for their purpose, and show as far as may be that perfect economy of perfect means which is seen in beautiful natural things They will then serve both for exercises in drawing and also for the improvement of taste. Their careful shaping and proportions, being governed by reasoned choice and imagination invest the lessons with livelier interest than is possible when geometrical models or ugly things are used.

For good design is not the offspring of idle fancy, but the studied result of accumulated observation and delightful habit. With examples of good design and good colour interest can be stimulated, and interest is the first condition of good drawing. It can be argued that drawing may be taught from dirty, ugly, or ill-made things, from tattered leaves and faded flowers, but even if this were true it would not serve, for skill in drawing is not the only or most important thing in art education. In this connexion the beauty of shape of traditional tools should not be overlooked. Comparison of a well-made felling-axe with an ordinary chopper, or a " french " cooking-knife with an ordinary dinner knife, will show what is meant. Wherever they will serve for drawing or painting lessons, traditional pottery, tools, and baskets should be added to the equipment. A sickle, a fiddle, a shepherd's crook, and the like suggest some of the poetry of common things and so widen interest.

It is sometimes thought that all suitable and desirable examples for study are necessarily expensive or rare, and as a consequence things which have but strangeness or irrelevant associations to commend them, and ugly things too, find places among models used for drawing and craft exercises.

To show the kinds of objects which should be selected the following list is given. In variety of form these cover more type shapes than a set of geometrical models, and so give a wider range of problems in draughtsmanship and this in much more interesting forms. Many of the objects, being brightly coloured, have additional attractiveness. Garish and dirty colours must be avoided. Comparison with some natural objects of beautiful colour will help here.

Sickle, felling-axe, bill-hook, shepherd's crook, sheep-shearing shears, wooden corn measure, stable lanthorn, cart or trap wheel, shovel, fork, garden trowel, riddle, garden basket (trug), watering-can, barrow-wheel, hammer, saw, plane, chisel, iron calipers, oil-can, mallet, bricklayer's trowel, wood shavings, iron shavings, packing-case, hamper, salt-box, bellows, aluminium saucepan, copper kettle or preserving pan, iron kettle, iron kitchen spoons, wooden flour-bucket, wooden chopping-bowl, flour-scoup, rolling-pin, wooden knife-tray, stoneware jug and bottle, stew-jar, blue-striped pudding-basins and mugs, tin coffee-pot, tea-can, oval milk-can, tun-dish, collander, hot-water can, tin candlestick, cane carpet-beater, wicker bread-basket, dinner-basket, chip baskets, chequered dusters and cloth, striped Turkish towels, ribbons, Indian matting, knots and balls of coloured wool and large reels of brightly coloured silk, hanks of wool and raffia, ball of thick string, glass jars used by chemists, tumblers, pewter ink-stand, pair of steps, deck chair, clothes-horse, folding screen, drum, bugle, horn and pipes, mandolin, fiddle, flags, kite, toy balloons, Japanese umbrella, coloured sunshade, palm-leaf fan, paper fans, tennis racket, draught-board and draughts, cup and ball, nine-pins, humming top, whip top, shuttlecocks, coloured-glass Christmas tree ornaments, necklace of large bright beads, coloured marbles, coloured lanthorns. The school itself, furniture and fittings, views of the interior and exterior, and of things seen from its windows or grounds, extend this list and include exercises in draughtsmanship which are not possible with small objects. Through these larger views a child may be led to see aspects of beauty in ordinary scenes and familiar places: in the wet street, in effects of fog with trees and commonplace buildings, in the gaunt silhouette of some derelict factory, in groupings of children in school and playground, and of crowds in the street.

Natural Objects.—Feathers, butterflies, pretty pebbles and stones in water, land and sea shells, birds' eggs, dried leaves—as of sea holly, oak and sweet chestnut—seeds and seed vessels of lilies, fritillaries, honesty, peas, winged seeds, ears of corn, oats, fir tree and other cones, dried ornamental gourds, pomegranates, fresh flowers, leaves and fruit, vegetables, leeks, onions, rhubarb, roots of coltsfoot, and bulbs in bloom in saucers of stones. Stuffed birds and stuffed animals are often used for the study of bird and animal forms, but there seems little need for them, they are often poorly modelled and wrongly posed, and with class use are soon spoilt. The subtle beauty of natural forms is very difficult to copy in stuffed specimens, and these at their best are without that life, movement, character, and structure which it is of more importance to show in a drawing than faithful rendering of surface. In place of stuffed things tame cage birds and pet animals should be used, and particularly observation of live things out of doors. A bowl of goldfish adds opportunity for drawing things in motion. This list may be extended indefinitely.

It may be well to add, in contrast to these, a brief list of things which, though often used, should be avoided. Ornamental pottery and cut glass, ornaments (so called) of many kinds, old boots and shoes, advertisements in any form, bovril bottles and bananas, tobacco pouch and pipe, variegated malformed or worm-eaten leaves and fading flowers, tattered feathers, a moribund aspidistra in an ugly pot, all objects specially made as models such as the " Greek " vases supplied with " regulation " sets of geometrical models.

Prints and photographs illustrating the history of arts and crafts.—The collection should be mounted in a uniform way to one or two sizes and arranged in cases, as books on a shelf, for convenience in handling. Good mounts which will stand hard wear should be used, and the mounting done by the dry process to prevent warping. The sizes of the mounts should correspond to those of a set of picture frames which have loose backs so that any group of examples can be readily framed and hung when it is wanted. On each example its title, date, material, size, and original position should be given unobtrusively. The collection will give a survey of the history of art and illustrate the best work in architecture and civic art. Photographs of sculpture will be supplemented with carefully chosen casts. If well placed, with lighting which displays its qualities of form, a fine cast may add beauty to a room or corridor, but the positions for casts need careful consideration. As a rule there are not many places in a school where casts will look well. When these places are filled the remainder of a school's casts should be stored and kept clean, that they may be changed with those on view. Some formal and orderly placing helps them. They should be related to their surroundings in some way, and their qualities brought out by suitable background and plain spaces round them.

Some electrotypes of fine coins and medals will prompt criticism of the coinage and medals of to-day, and suggest the modelling of medals for school commemoration and other purposes.

Paintings.—Where these are good the reproductions will be in colour. Representative works from the Italian, Flemish, Dutch, French, Spanish, English, and German schools will be illustrated, and these will be supplemented by reproductions of drawings.

Etching, Engraving, Woodcutting, and Colour Printing.—Here it may be possible to have some originals in addition to many good reproductions.

Furniture, including illustrations of period rooms and interior decoration.

Metal Work, including gold and silversmith's work, wrought and cast iron. Of silversmith's work some illustrations should be chosen for contrast with modern school shields, trophies, and sports cups with a view to the improvement of these usually ugly things.

Fabrics, woven, printed, and embroidered. Costume, illustrating particularly English and European costumes.

Writing and Illuminating and Lettering, illustrating the development of fine writing, some of the notably beautiful manuscripts, printing, and the growth of the book.

The collection of photographs and prints here suggested may be supplemented in some crafts by actual specimens: in a girls' school beautiful fabrics may show the essential qualities of cotton, linen, silk, brocade, velvet, damask or printed materials, and the patterns suited to each. In making a choice the following should be remembered: originals will probably be unobtainable and reproductions must serve. Indian and eighteenth-century printed stuffs, Paisley shawls, Spitalfields silks and brocades, Italian and Chinese silks, Genoese velvets, old hand-spun and hand-woven linen should be among the examples. These may serve other uses in the art room from time to time.

Full use should be made of the many reproductions of beautiful things and well-illustrated books to be obtained at little cost from the British Museum, the Victoria and Albert Museum, Tate Gallery, Natural History Museum, and Ashmolean Museum. It has been found a good plan to put some of these on sale at school. A selection might be specially made from time to time to illustrate and amplify current school lessons, lectures, or public exhibitions. Full advantage should also be taken of the arrangement by which loans are made to schools from the Circulation Department of the Victoria and Albert Museum. When possible, visits should be arranged to these and to local museums. In the reference department of the libraries of most towns there is often material useful to art and craft teachers which is seldom used. If the school collections are to be of maximum value they should be large enough to illustrate various influences, artistic, historical, geographical, and commercial. But this may easily lead to the negation of the prime purpose of the collections as anthologies of beauty. For the issue becomes confused and ugly things may assume importance. It is better to have a few things well displayed and often changed than many things on view continuously.

Pictures.—With the provision of prints and photographs for use in the art room, those pictures which are used for school decoration must also be considered. The selection and hanging of them are matters of importance to the art teacher, for their prime purpose is æsthetic. The sources of school pictures are roughly three. Consideration of them suggests the best uses of pictures in schools and the places where they should be hung. (1) Reproductions from old and modern masters. These are of permanent æsthetic value. (2) Pictures made primarily for advertisements. These will be used mainly for their decorative value. (3) Photographs and prints. Many of these will be used for purposes of direct instruction.

The masterpieces of painting reproduced in the first group were painted to be shown indoors, and their scale is appropriate to indoor things and living-rooms. The photo-mechanical reproduction of them involves loss of quality, and this loss is greatest where the originals are large and dark. Where an original is of modest size, and light and crisply varied in its tones and tints, the loss is less. The finer and subtler the original, the more likely is the loss to show in the reproduction: its poorer quality may hardly be noticed where but one reproduction is seen, but where many are shown together the loss is usually apparent in a certain flatness, uniformity, and loss of depth. So it is well not to hang many together.

The originals of the second group were designed to be shown out of doors in public places, and for this reason are larger in scale with an emphatic technique which tells at some distance. Both by their design and also by reason of their methods of reproduction such pictures are striking in their contrasts of colour and form. Their technical handling is usually in harmony with the passing interest of their subject-matter. They do not aim at satisfying permanent interests or strive to compete with masterpieces of painting. So when picture posters, or their like, are used they should be hung in big rooms, on staircases, or centrally in large vacant spaces, well above the eye-level where their decorative value will help a bare room. They should be often changed, for the eye tires of overemphasis. Reproductions of masterpieces cannot be hung near them without detriment. These finer things are best hung on or near the eye-level where their subject-matter and technique can be studied. The difference between these two kinds of school pictures is roughly parallel to the difference between a band out of doors and string instruments in a room.

The originals of the third group, photographs and prints, are associated with books and folios to be looked at in the hand, where delicate and varied detail can be appreciated. If they are used for wall decoration they should be placed on or near the eye-level, and since they are small they should be hung in groups so that the size of group forms a unit in relation to the wall on which it is hung. Small pictures are best hung in small rooms, not in the larger classrooms or school hall. Of fine prints, in which may be included original etchings, engravings, wood cuts, and colour prints, a school may possess originals. Such prints look well when hung in a school library where they may be quietly enjoyed. Their modest price will show that all may enjoy the pleasure of original works of art. For to create a lively interest in and encouragement of contemporary artists and their work, is one of the purposes of art teaching.

No picture should hang in one place until familiarity leads to neglect; one fine picture well placed and changed from time to time will arouse more interest than many poor prints which are never moved.

Pictures which are used as aids to classical teaching, history, geography, and botany are dealt with in *Ante Oculos*,[1] by John Penoyre, and in *Charts and Pictures for Use in Schools*.[2]

Educational Pamphlet No. 52, issued by the Board of Education, should be read for its reasoned comments on *School Pictures*. In this pamphlet the subject is fully considered and its summary of conclusions fairly covers all points.

The following is a list of pictures to begin with. It is limited to those which are available in colour and good as reproductions. To bring them within the reach of the many, cost has been considered.

Monkey and Plum Tree	*Japanese*	Fine Arts Publishing Co.
Bouquet of Flowers	*Dutch*	
House of Lords Panels (6)		
Earl of Surrey	*Holbein* (?)	
Child gathering Flowers	*Laura Knight*	
Winter Landscape	*P. Breughel*	Messrs. Zwemmer.
Dancing Peasants	„	
Merchant Gisze	*Holbein*	
Bridge at Argenteuil	*Monet*	
Portrait of a Boy	*Pinturicchio*	
Bridge near Arles	*Van Gogh*	
Afternoon with the Children	*Renoir*	
Portrait of a Venetian Lady	*A. Dürer*	
The Banks of the Seine	*Sisley*	

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[1] Oxford University Press.

[2] British Association for the Advancement of Science.

Christ and Peter	*Ford Madox Brown*	Medici Society.
G. Washington	*Gilbert Stuart*	
Portrait of a Man	*Titian*	
Madonna, Child and Angel	*Fra Filippo Lippi*	
Head of a Young Woman	*D. Veneziano*	
St. Francis and the Birds	*Giotto*	
Old Man and Grandson	*Ghirlandaio*	
Man with Turban	*Jan Van Eyck*	
Helena van der Schalke	*Terborch*	
The Little Street in Delft	*Vermeer*	
Woman peeling Apples	*P. de Hooch*	
Courtyard of a Dutch House	,, ,,	
Child with Parrot	*Miereveld*	
Bridge over the Stowe	*Constable*	
Boyhood of Raleigh	*Millais*	
Nocturne	*Whistler*	
Thomas Carlyle	,,	
King Richard II	*Beauneveu, André*	
Henry VIII	*Holbein*	
Morte Fontaine	*Corot*	
Spring	*Laura Knight*	
Epsom Downs	*Munnings*	
Celandine	*A. Dürer*	
Owl	,,	
Wing	,,	
Self Portrait at 13	,,	
Courtyard—Innsbruck	,,	
Bunch of Violets	,,	
Hare	,,	
Grasses	,,	
Columbines	,,	
Interior of a Dutch House	*De Hooch*	Messrs. Black.
Avenue at Middelharnis	*Hobbema*	
Girl at Window	*Rembrandt*	
Head of Old Woman	,,	
Infanta Margarita	*Velasquez*	
Maids of Honour	,,	
Blue Boy	*Gainsborough*	
Miss Bowes and her Dog	*Reynolds*	
The Age of Innocence	,,	
Anne of Cleves	*Holbein*	
Ulysses deriding Polyphemus	*Turner*	

CHAPTER III

Colour Work, Painting, and Appreciation of Colour

Lessons on colour often begin with the making of colour charts and with the theories on which they are arranged. As a consequence a child's delight in pretty colours is annulled with adult reasoning, and remembrance of a rule confounds happy choice. Colour theory and analysis taken step by step in weekly lessons covering half a year or so exhaust natural interest and dull spontaneous preference, which are the best foundations. Elaborate theories of colour act as a blight, are unnecessary, and a waste of precious time. Enjoyment of beautiful colour should be the aim from first to last. A child's pleasure in bright colours and telling contrasts may be led, with no theory to help it, through enjoyment of tender hues, and rich harmonies of colour of lovely quality, to the appreciation of subtly related tones of neutral colour, and to delight in them all. For all have their places in æsthetic enjoyment There should be no theory of colour or a minimum of it, but there should be, what is very rarely given, a maximum of opportunity for enjoyment of fine colour. It is not without significance that illustrations to books on the theory of colour almost invariably shock a sensitive eye. For theories and principles of colour are developed, as a rule, from the scientific side, not from feeling, but from the number of vibrations of a colour to a second. They usually leave out factors and qualities of prime importance, such as gradation, texture, transparency, translucence, sheen, gloss—qualities which cannot be brought to rule, but which, giving beauty and variety to colour, may change poor hues and poor harmonies to good ones. Appreciation of the æsthetic qualities of colour is too subjective a matter to be wholly guided by law and principle. However good the theories, they cannot take the place of feeling and sensitiveness. These guide right or wrong choice and they must be exercised continually. Theories and principles of colour offer suggestions for the arrangement of exercises in sequence, but a teacher will not put theories and principles first; they may arise as a result of enjoyment and experiment, and they may lead pupils to question preferences. It is understood that a teacher will use what follows in this sense, giving technical lessons as need arises for fuller expression. Love of fine colour and taste develop through a lively exercise of choice among good and better things. A teacher should continually put pupils into the position of having to make such a choice. Taste is akin to conscience, and grows with use.

Basing the selection of the object, or effect to be studied, on interest and beauty, the teacher will find that lessons may be fruitfully developed from the following: *the effects of contrast*—light colours on dark, and dark colours on light grounds, and the effect of light and dark outlines; *contrasts* *and harmonies*; *qualities of colour*, such as those already mentioned; *analyses of art and nature's schemes of colour*; the *invention of schemes suggested by ideas or by things* such as " a melon's dripping sherds, a cool sky's minor thirds ", spring, joy, fire; the *harmonious balance of neutral tones* and of black and white offer other exercises and the *effects of different lighting* others. Further exercises, which will come first in practice, are technical, and arise from consideration of tools and materials.

Tools and Materials.

Tools and materials used are coloured soft chalks and pastels, water colours, colour box, brushes, and papers. Pastels and coloured soft chalks offer to children the readiest means for practice with colour, for they are easier to handle than brushes, water, and a colour box. A selection of six spectrum colours, red, orange, yellow, green, blue, violet will serve for junior class work, but for more advanced classes additional tints of red, green, blue, with black and white, and a rich dark brown should be added. Although they are used as colours, the relation of coloured chalks and pastels to drawing should be remembered. They do not naturally give full and solid renderings: their better use is to suggest colour and light. By artists they are oftenest used for slight sketches and studies, and for light and gay effects. But with children their suitability for suggesting effects is rarely appreciated; the joy of rubbing on thicker and thicker patches of solid colour takes its place. Therefore it is best to choose for exercises objects which have not map-like areas of plain colour, but things having some linear qualities in which drawing and liveliness of colour effect count most. A child's toy trumpet, a Japanese fan, or a striped tulip illustrate what is meant in contrast with, say, a box of unrelieved colour, a felt hat of strong plain colour, or a crinkled rhubarb leaf.

Much depends on the choice of suitable paper for pastel drawing. It should be of medium tone, neither light nor dark, for light colours must show on it and dark ones too, and both must seem to be related to the ground—the paper. They must not stand out sharply from it or they lose the value of the ground which, suggesting half tones, ties lights and darks together. For a similar reason, the colour of the paper should be of a neutral tint, not a positive hue—a cool or " dove " grey does well, for it ties together the warm and cool colours. (The sarcastic comment of a cross teacher—"the plain ground is the best part of your drawing"—suggests the value which the untouched paper can give to a drawing.) The paper should be neither too smooth nor too rough, but just rough enough to make chalks and pastels " bite " on it. The choice of surface depends on the hardness of the chalks and pastels, and as some makes are harder than others, paper and pastels must be tested together. It is better, probably, for the paper to be a little too smooth than too rough, for if it is too rough there is waste of pastel and lots of mess. Good pastel papers are available from which selection can be made.

Pupils in senior classes should be given a choice of mediums, and of using pastel if they prefer it. For some subjects the opaque qualities of pastel will be more suitable than transparent water colour, and variety of rendering in the work of the class should be encouraged. But because exercises done with pastel have a tendency to be vague, indefinite, and to look better than they are by reason of the softness and bloom characteristic of this medium, a teacher should balance studies in pastel with work with a point, and for colour exercises use water colours as soon as the class can deal with these less manageable materials and tools. A good list of colours to begin with is light red, alizarine crimson, cobalt, prussian blue, yellow ochre, and areolin. Rose madder may be substituted for alizarine crimson, and raw sienna, burnt sienna, viridian, and vermilion may be added for use in design. It is well not to have many colours, but those selected should be good. Garish colours, such as cheap emerald green, invite crude and inharmonious use, and there is virtue in a restricted choice apart from the fact that only good colours are chosen. The possible combinations of a few colours are more easily learnt than those of many, and the mixture of many pigments leads to dirty and opaque colours.

Some colours are easier to use than others, and preliminary trial exercises will be best practised with them. Yellow ochre is the easiest to use in a wash, prussian blue is usually the most difficult. The paper to be used for water-colour painting should be selected with care. Shiny or hard-surfaced paper should be avoided. When the areas of colour to be put on are small, thin paper serves very well; large washes cockle it. Good papers which are heavily sized are not so pleasant to use as poorer papers which are slightly absorbent. Where there is too much size it may be washed out by soaking the paper in water. Many colour exercises can be done quite well on good cartridge paper. If this is chosen with a view to drawing and painting, it may serve for practically all exercises. Three or four brushes are necessary, a small one for drawing, a medium-sized one for general use—it is best to have two of each of these—and a larger one for washes. Good red sable hair brushes are expensive, but there are usable substitutes. Cheap brushes are useless as a rule.

It is a mistake to have a large and elaborate colour box, for there is a temptation to fill it with many crude and poor colours. So long as it provides space for eight half pans, and has generous spaces for mixing washes of colour, it is big enough. Brushes should be kept separately where their points can be protected. If there is space in the box it may be used to keep tubes of moist paint for replenishing the pans. By squeezing out a little at a time the colour is always ready for use, and the life of brushes, which are soon worn out by scrubbing off colour from hard cakes, is lengthened. Good brushes well repay careful keeping and usage.

Exercises such as these which follow should be given parallel with other colour work, and related all the time to beautiful and interesting things. They deal with changes and qualities of colour in the order in which children usually discover them, or may be led to appreciate them. Precocious children may see the various tints and shades which an object of one colour shows from its light to its dark side, but most children up to the age of 10 or so see local colours only: a red carrot appears to be all of the same red, and a painting of it in one colour satisfies them. It will not be forgotten that the value of these technical exercises lies in developing a subtler sense of sight and wider appreciations of loveliness in art and nature. We see what we come prepared to see.

(*a*) *Laying of washes.*—It is not easy to lay a good wash of colour, and the darker the colour the more difficult it is to secure an even wash. But it is worth while making each wash to be laid an exercise to better the last, for good colour well laid on with a full brush has a beautiful quality of its own. This may be seen in the work of the early English water-colour painters, whose work should be referred to for its perfect handling of the materials and varieties of technique. Practice in laying washes naturally arises from trying the colours which are in the box. At first the areas to be covered should be small and simple in shape. If the space to be painted is a good size it is well to wash it over with clear water first, and work on it when it is slightly damp.

(*b*) *Trials with colours in the box.*—What the colours are, and how they change each other, may be shown by exercises with washes in which the various colours, in wide bands, cross each other as tartans do. Many such simple patterns may be made in this way, using the colours at different strengths, and with bands of varied widths.

How colours change or modify each other may be seen by drawing some circles, damping them, and with the paper flat, letting two or more colours run together within each circle. Circles so coloured often resemble soap bubbles or balloons.

(*c*) *Exercises with one colour* to show its range from pale to dark should be done next. In a series of spaces a pale flat tint is put at one end, and a dark one at the other, and the scale completed with flat tints which are made darker in each succeeding space. This gives practice in judging a required tint and in mixing it.

(*d*) *Variations of tone in one colour.*—A study painted in one colour will show that making a colour deeper does not represent changes due to shade and shadow, or give the variations in colour which are reflected from adjacent things. This will suggest the making of a scale of colour which grows darker in tone without growing more intense in colour. The same object used before for a painting in one local colour should then be painted again. The practice of painting a subject in monochrome to give its light and shade, and afterwards adding washes of transparent colours over this, should be referred to and studied in the work of early water-colour painters. The scales made in (*c*) and (*d*) can be used to suggest (*e*), *the colouring of patterns* which are best hectographed for the purpose. Simple geometrical diapers quickly drawn will do. But to familiarize pupils with examples of fine patterns it would be well to reproduce in outline such patterns as those of the diapered pavement in the Baptistry at Florence (enlarging them from photographs by Allinari of Florence), or to take some other noble patterns, such as will be found in *Pattern Design* by A. H. Christie. Selecting from the scales a group of tints, or a group of tones, it is found that one combination gives a pleasanter effect than another. A few tones, or tints very nearly alike, will look insipid, and the use of the darkest with none but the palest washes makes too strong a contrast. A nice balance is necessary. This may be obtained by distributing the colours in various ways and in various quantities. The pretty spacing of black and white on the wings of common butterflies shows such distribution. How varied *tones* (*d*) may give added beauty, may be illustrated with black and white, which have no beauty of hue to enhance them, by comparing a plain area of dead lamp black with a sleek black cat or a jackdaw, and with even white paint an irregular wall white-washed, white silk, or a white cloud. (*c*) The floor, walls, and ceiling of rooms drawn to scale, folded to position and coloured with a sequence of blues or reds, will give exercises in tints of a colour, and recall pleasant old rooms decorated in the same schemes: " the blue closet ", " the yellow room ", such rooms used to be called. Incidentally it will be shown that most of our living-rooms, in the decoration of which many colours are used, are not so restful or so beautiful. Schemes for dressing a doll, for a piece of embroidery, or for trimming a hat give other opportunities for exercises of the same kind.

(*f*) *The different hues of one colour.*—When different tones of a colour (degrees of darkness, not intensity) can be recognized, its various hues can also be distinguished. For these, as for other changes of colour, a teacher will invent ways of making the differences clear. For instance, one colour may be taken and its many variations shown by collecting as many objects as possible of that colour. Let us suppose the colour chosen is red. The objects will be put in a series ranging from yellow-reds, as a richly coloured orange, to the cooler reds of logwood chips, or chips of yew-tree wood, a red brick or tomato. The colours which are somewhat alike are made neighbours. So a sequence, and order, is brought into diversity, and it is shown how the hues are related. Freshly broken pieces of old bricks, which have been weathered for a century or more on some of their faces, will in themselves show a lovely range of differing reds, and explain, in miniature, the difference between the appearance of an old village and a brand new suburb. Bundles of patterns of plain fabrics—casement cloths, silks, and linens—will be found to multiply varieties of colour. The matching of such sequences provides useful exercises, more or less difficult as the colours and differences between them are more or less subtle. As out-of-school exercises in this same direction, pupils may be asked for such things as the following: to give varied reds seen in fire; to show the difference between the yellow of mullin and sunflower; to show the different tints or tones in the plain ground of an old eastern rug or carpet, and make a comparison with a modern " Turkey " or English carpet.

Colour Nomenclature and Colour Scales

An endeavour should be made to increase the number of names which a pupil has for colours, and when ordinary terms fail, to encourage the invention of epithets which designate colours and tints. It will be seen how difficult it is to define a colour in words, say a standard central red, which inclines neither to yellow nor to pink, by common similes which, while they seem to define, each refer to a different kind of red. For instance: as red as fire; as red as blood; as red as the rising sun, as a turkey cock, as coral, as a carrot, as a hip, as sealing wax; " The whole hillside was redder than a fox ". An exercise painted from memory of the things named in these similes can be made to show a sequence from yellow-red to purple-red in a scale somewhat like the scale above mentioned made from red objects. Similar exercises will deal with other colours: yellow, blue, and green—this is a good order to take them—for niceties of colour will not be hit at the first try. Such scales lead to the much more difficult problem of analysis of changes in colour which are due to various lighting, and to light and shade. Such are the changes to be seen in the colour of the walls of a room which are painted one colour, on an orange, or on a tree in full foliage. This is an important and difficult piece of training in appreciation of colour, for it is not easy to dissociate what is known from what is seen. In this we rarely believe our own eyes. We learn from painters to see things as they appear. Some precocious pupils will see more than others. They may need little or no prompting to name the colours which, say, a green grape shows from its high light to shadowed side, when other pupils are content to paint it one plain green. To help pupils to perceive changes caused by different lights, it is well to put pieces of pottery, paper, or fabric of the same colour about the room where the effects of various lighting, from sunlight to deep shadow, can be compared. To help in discriminating the same changes on an object of one colour, variously lighted patches can be isolated by looking at them through a tube. It is worth while taking much trouble to be able to see the infinite variety and beauty which is due to varied lighting, reflected and coloured light, for an effect of light will transform the drabbest daily environment. Few of us are able to see in a sunlit room anything like Turner's *Interior at Petworth.*

Gradated Colour

There will probably be difficulty enough if these exercises are made in flat washes, but the need for gradating a colour will be felt when some natural thing shows the beauty of gradation in a striking way. It is not hard to collect examples which show the beauty of gradated colour: scallop shells, flower petals, leaves of daffodils and grass, others among nature's obvious lovelinesses—the sky at sunrise or sunset, and the blue of the sea. Painted studies should be made of some of these. A series of pairs of gradated and ungradated colours would form other exercises.

These may be seen and contrasted in, for example, petals of scarlet geranium and wild rose, begonia and peony, cultivated pot hyacinth and wild hyacinth (bluebell), " market white " and any other white chrysanthemum, pieces of machine-made red brick and old hand-made brick, and, from memory, the blue sea and the blue of the " blue bag ". All colour in nature is gradated, Ruskin says in *Elements of Drawing*, a book which art teachers should know. Pupils may be helped over the difficulty of making gradated washes by trying them first with easy single colours, and in simple spaces not too large. After practice with one colour, say yellow ochre, from a pale tint to its full strength, or vice versa, in a given depth of space, two related colours, as yellow and raw sienna, or light red or yellow to dark green, can be made to follow each other in the same space. To make gradations which, beginning with one colour, run through to another colour quite different, as yellow going through greens to blue, will be found to be more difficult exercises.

Texture, Translucence, Transparence

The value of texture in giving quality to colour is readily shown as a class exercise, by putting a wash of one colour over a series of slips of paper of different kinds and a slip of silk. The series should include a range of the following: " Art " paper with the excessive surface finish of that used in *Country Life*, or any other white, coated paper, a poor, smooth and a good, rough cartridge, hot pressed and heavily-sized water-colour paper, ordinary " Whatman's " or O.W. paper, and a rough, absorbent water-colour paper such as " Creswick ". The papers which are called " David Cox " or " Varley " may also be included, and a good Japanese paper and cream white silk. It will be seen that the same colour looks better on some grounds than others, and that the difference is due to texture and to slight absorption. Roughness breaks up the colour with minute shadows and gives value to it, and slight absorption gives depth to colour which looks thin and poor when it lies on the surface of coated and smooth papers. Silk, by its texture, absorption, and sheen, adds much to the quality of colour. On some textures no colour will look well, but a good texture enhances any colour.

The value of transparency can be noticed if some washes are put on with brushes nearly dry, and others with a full brush flooded on, and the two washes so made compared with each other, and also with the still liquid colour in the palette.

Differences of quality due to texture will be seen by comparing linoleum, matting, and pile carpet of the same colour. Slate roofs, which may be seen from the art room, provide other illustrations of the value of texture if they show varieties of slates: Welsh, Westmorland, and others. A comparison of flower petals, where some of the loveliest textures will be found, will provide further examples of the value of texture. For instance, it will be seen that between the colours of pansies and rose petals on the one hand, and the colours of pyrethrums and begonias on the other, there is loss of quality, quite apart from hue, and that the loss is due to difference in texture and to translucence.

Other good textures are seen in melons, egg shells, rough grass, ribbed sand and bark, the polished acorn in its dinted cup, feathers and fur (which make a beautiful foil to flesh). Blown glass should be compared with cut glass, and hammered metal, carefully polished, with lacquered shapes of stamped metal. Consideration and comparison of the *colour* of these show that natural structure or beautiful workmanship in any material gives a subtler and wider variety of related tones than can be produced by mechanical means, and that this variety has the immense advantage artistically of being bound up with, and expressive of, structure and form. For many lovely and characteristic textures the Japanese have special names.

Pottery, porcelain, china and stoneware, stained glass, shells, polished stones and marbles, pebbles under water, sunlight through leaves, wine in a glass (wine spilt on white paper gives quite a different colour), show the value of translucence and texture in enhancing the quality of colour. Few things of man's making have more subtle beauty than fine pottery and porcelain. The colour qualities which make these beautiful can hardly be imitated, but an endeavour should be made to render them in water colour, because failure, or approximate success, makes clearer the loveliness of the originals. The difference in quality between printed and painted wares and under-glaze and over-glaze colours, can be shown with actual specimens, and similar differences in quality should be noticed in other things. A visit to a good museum could be profitably spent in appreciation of the characteristic beauties of pottery and porcelain. Collections of coloured materials, wall-papers, fabrics, enamelled and painted wares, tiles, pottery, china, &c., should be made by the class for comparison, and colour studies with notes made from them.

Bright and Garish Colours

Left to themselves most children use the strongest colours. The children's choice can be questioned and improved by comparing it with nature's way of using strong colour in things which are a delight to children —toadstools and fungi (the little points of vermilion-coloured fungus which are seen on decaying bark, and brilliant elf's caps nestling among moss will be remembered), brightly coloured butterflies and insects, birds with gaily painted plumage, and alpine flowers. It will be seen that in these the brightest colours are distributed in small quantities, that they have a rich or dainty brilliance which flat washes of strong colour cannot give, and that a colour must not be uniformly flat or monotonous unless it is very pale, very dull, or very dark. The sharp gradations which are seen in the colours of a peacock's feathers, or on the lip of *Gentiana acaulis*, show what nature does with her strongest colours. Good colour is generally clear and bright, and poor colour dirty, heavy, opaque, and flat.

Modification of Colour by Contrast and Reflection

All colour is modified to some extent by its surroundings. This may be in two ways, by direct contrast and by reflection. The effects of direct contrast are seen at their maximum by trials with white on black, or black on white, and with colours on grey. For instance, it can be shown that pale tints are destroyed by strong contrasts. Because of this, babies are not dressed in black but in pale colours which enhances their delicate colouring. So the same white ducks look sparklingly clean on a dark sunlit water and dirty on snow. It will have been noticed how dainty the hoar frost makes foliage and grasses, which otherwise look dark and heavy in a winter landscape. When, as happens sometimes, the hoar frost hangs in a little border around the edges of green and ruddy leaves, it will be seen how the white outline strengthens and clarifies their colours. The same effects on coloured patterns should be tried by giving one a white, and another a black outline.

Of the effects of reflection, very brightly coloured objects or things of polished metal make most difference to colours near them. Two groups, one of oranges and another of apples, will show what is meant. Their effect can be demonstrated further with any brightly coloured fabric or by the coloured walls of a room. Reflections from clothes may be becoming or otherwise, according to the colour of the garment and complexion of the wearer. This can be shown with two coloured scarves, one a warm and the other a cool colour. The varied or total changes of colour made on the stage by a strong light reflected from coloured cloths should be mentioned. Interplay of reflections, which we saw among a group of oranges, may be seen also among sunlit houses in a street, or small things in the classroom, and provide many exercises in painting for senior and advanced pupils.

Variety in Colour

Pupils should be led to see that nature's colour is rarely or never flat and uniform, even when we claim to admire it for that reason, saying in praise " perfectly even ", " a perfect sheet of blossom ", " the sea was a perfect sheet of blue ", as if even and complete uniformity were its virtue. Is there no choice in beauty between a green field and a green door of the same shade? In what lies the difference? The selection and arrangement of pieces of fabric, or of plain wall-papers of various colours and textures, in order of their beauty of colour, with a colour analysis and reasons for the choice, will lead to avoidance of those colours which look dead and lustreless, flat, and mechanically even.

Among fabrics, the colour qualities which come from hand weaving and the use of vegetable dyes will be discovered, and the choice among wall-papers will lead to questioning their value when compared with a plain wall or wainscot. The subtly varied colour of a healthy complexion, and the difference between it and wax-work or painted and powdered flesh will be brought to notice, and consequently some of the reasons for the difficulty of flesh painting will be realized. A wash of flesh tint can be compared for variety with a pupil's hand. To develop appreciation of nature's beauty, senior pupils should endeavour, among other exercises, to set down the films and tender interlacings of various colours which represent the sea we call just blue, and to notice how much variety of colour there is to the square inch of painting of the sea in the work of Tuke, Moore, Hook, Whistler, Brett, Olssen. In this connexion, two ways of making a given colour should be tried side by side for comparison of quality and brilliance: in one by direct mixture in one wash, in another by putting pure touches of the necessary colours side by side and allowing distance to combine them.

Such study and exercises lead the way to enjoyment of things which are accounted loveliest in colour: fine Eastern rugs and carpets, Persian and Chinese pottery and porcelain, stained glass as at Canterbury, York, Malvern, and Chartres, painting such as Titian's, Metsu's, and Rossetti's.

In nature and in natural objects *harmonies* of colour may be found in plenty. Pupils should be led from enjoyment of them to notice that the relation of the colours to each other is a source of their beauty. For instance, in a dandelion the yellow of the flower changes to greenish yellow which, in turn, changes to yellowish green and full green in the leaves: and toadstools vary from cool brown to red brown and red on a carpet of dun-coloured larch leaves, as if the colours of each acknowledged one colour as dominant. This unity in diversity is sometimes obtained in practice by using the same brush throughout (without cleaning it between the separate operations) for mixing all colours of a scheme, or by putting a small quantity of each colour into others, or of another colour with all. The practice easily leads to loss of freshness and the scheme may become passable only because of a certain average dullness. It will be remembered how cool moonlight, warm sunset, or haze veil a landscape with colour which modifies all colours. So yellow varnish unifies the colours of an old picture. By using thin talc or gelatine of various tints, a pupil can see how any scheme may be unified. Exercises in deriving harmonies from suggestions in nature for use in decoration and design should be done frequently. These may be from memory or from briefly written notes made by pupils or from dictation—a beautiful harmony being recalled by the teacher. To keep the eye alert to see harmonies which may be found everywhere, the widest range of things should be drawn upon: autumn leaves which strew the warm grey concrete pavement; a dull red wagon dirty with rich brown mud and laden with golden straw; freshly cleaved timber with its bark of yellow, brown, and dull madder colours; bluebells in a wood, and woods in spring. So that the lesson may be one of colour only, the hectographed patterns already mentioned may be used, the colours of the scheme being distributed over the pattern to give the desired harmony. Or the pupil may be asked to invent a pattern the forms of which are also suggested by the subject which gives the harmony of colour

While harmonies of colour may be seen anywhere, and may without much difficulty be used as colour schemes, nature shows few *full contrasts*, and these are more difficult to use in design and decoration. By full contrast is meant the opposition of two colours which intensify each other. Colours which are not full contrasts make each other assume a complementary hue. So red appears to be more rosy when contrasted with yellow, and yellow assumes a greenish hue. To see how one colour may call up its opposite, the class should make experiments: for instance, spill a dozen or so vermilion berries of cotoneaster over a black ground and notice how the black assumes a greenish tinge; various scarves, or cloths, blue and sandy, may be tried for effect on a red-headed, fair child. Wherever possible, the exercises should deal with some practical and ordinary problem. The delight of children in strong colours shows in their preference for striking contrasts rather than for quiet harmonies. Such an effect of contrast, with which all may be familiar, occurs when, before curtains are drawn, the warm lamp is reflected on the window and seems to hang in the intense blue of the evening sky. So the red sun sinks in a land of blue mist. Children may be asked to paint, as something of a daylight parallel to this contrast of warm yellow and blue, some yellow-hammers and a robin, with their breasts shining in the sun, perched above them on telegraph wires against a clear blue sky. A kingfisher's red breast and green-blue plumage show a variant of a similar contrast; the seed and flower of *Tropæolum speciosum* show another. Perhaps the most striking use in art of this exhilarating contrast of blue and red is to be seen in stained glass of the thirteenth century. But contrasts of colour in nature are rarely so strong; large areas of such vigorous contrasts would hardly be bearable. So, as contrasts are broken and modified, the more often they occur, the more easily are they adapted to artistic uses. Red-brown sails seen against the sea show one of the quieter contrasts. Parallel with exercises in deriving schemes of colour from natural objects, similar studies should be made from fine pictures. And because the problem is somewhat simplified in Japanese prints, it has been found well to begin with these if good prints can be had. The subject-matter of pictures has been the main interest of juniors, but senior pupils should endeavour in their analysis to find the mood or significance of a colour scheme, and realize that felicitous appropriateness in this is of prime importance.

Equipment

Lessons in colour will draw on the equipment of the art room, which has already been discussed. For their especial value in lessons on colour, other things, such as the following, should be added: pieces of birch bark and parchment, brightly coloured insects and butterflies, birds' feathers and plumage, pieces of mother o' pearl, minerals, iron variously rusted, dried leaves and seaweeds, lichens, flowers. (Schemes of colour will be suggested by these as, for instance, in a robin—citron, brown, red brown and red: in a blue tit—gray, greens, and blues: in the feathers of a sparrow or the rich browns of a woodcock's feathers—a harmony of related hues and tones of browns.) To this equipment a kaleidoscope should be added not as a toy, but that varied proportions of colour in a scheme may be studied, and it should be so made that selected scraps of colour may be easily changed in it. A "Bath-oliver" biscuit tin makes a good instrument and a sixpenny kaleidoscope will show how it is made.

Conclusion

It should be remembered that the lessons in painting and colour work are not *primarily* for the education of painters, but for training sensitive vision in all, so that the beauties of art and nature may be enjoyed. Things and aspects of our ordinary environment should, therefore, be referred to continually and made the subjects of exercises and tests, so that an untiring habit of appraising and choosing is formed and kept growing. By this means alertness and sensitiveness of vision may be developed continually, and outside the classroom more than in it. Without such continual exercises the sense of sight will but register old preferences in a more and more perfunctory way. So far from resting content with early appreciations, continual and increasing enjoyment of nature and art should result. Taste in all matters which administer to æsthetic delight is ordinarily settled early at a pitiably low level and rests the same for life.

Instinctive choice is necessary for rapid and spontaneous work, and the training should continually exercise this choice. The factors and conditions which produce an infinite number of beautiful colour harmonies in art and nature are too complicated and various for easy solution by rule, and the makers of the loveliest harmonies are strangers to theories of colour. The harmonies proposed by the intellect, and the more recondite and subtle preferences which are born of sensibility, are not the same. Supposing infallible rules for harmonies could be made, it would, in the nature of things, be unwise to use them—for a system would stultify the sensitiveness which we must cultivate, a sensitiveness which should be instant in its appreciation, reach farther than a rule, and be of the kind from which rules are deduced.

CHAPTER IV

Carving

Carving in Wood

TOOLS: A few well-chosen tools are better than many. A pupil should become well acquainted with these and know what they will do before adding to them. A dozen or less will serve for simple work, and as the need for other and special tools is felt they can be added to these.

Chisels: ½″, ¼″, in spade form: ⅛″ flat and ¼″ corner chisel.

Grounders: bent chisels ⅜″, 1/16″, and a 3/16″ corner grounder.

Gouges: three in spade form ½″, ⅝″, and ½″ of varying sweep; six of varying sweep in straight form ½″, ⅜″, ¼″, ⅛″, ⅛″, 1/16″; 3/16″ parting tool. This should have a square cutting edge.

Joiners' Tools: A keyhole saw, a "bull-nose" plane, and a chisel of about 1¼″ wide. The following further tools should be available in the craft room:

Three gouges with a deep curve, ⅜″, ¼″, and ⅛″

Three front bent gouges, ⅜″, ⅜″, 5/16″, and a 3/16″ maccaroni tool.

Sharpening stones: a coarse washita and a turkey stone; slips (rounded slips for sharpening the insides of tools), one of washita and a "knife-edged" arcansas stone for the smaller tools; a round beech carver's mallet and an oil can. A very steady bench with firm and solid top is necessary. Its ends and front should project enough to allow for clamps for holding the work in progress: it should have a joiner's bench screw. To fix the work there will be wanted 4½″ screw clamps and notched wooden blocks made to clip over the edge of the board to be carved.

WOODS: Yellow pine and close-grained English oak will serve for soft and hard woods. To these may be added mahogany, Italian walnut, cherry, pear tree, box, briar, ebony, sandalwood, lancewood, for small work. Small pieces of various sizes and shapes prompt the imagination and often suggest both treatment and subject.

Carving in Stone, &c.

TOOLS:

Flat chisels: 1/16″, ¼″, ⅜″, ½″, and 1″.

A few bull-nosed chisels of various sizes for curves.

A few skewed chisels for backgrounds and corners.

Wooden mallet, or mell, about 5″ diameter, a zinc mallet or "dummy" of about 2″ diameter and a stone-mason's hammer of small size. The chisels may be hammer headed, mallet headed, or have wooden handles. For large work the two latter kinds of chisel are used with a mallet or mell. The hammer-headed chisels will be used for small work with a dummy, or with a hammer for ordinary work. Rasps and rifflers.

Water and a piece of grit stone will be needed for sharpening. The tools will need tempering, which may be done by the toolmaker, but if pupils can do this so much the better. Highly tempered tools will be needed for the hard stones.

STONE, &c.: Alabaster, slate, clunch-chalk, bath stone, portland stone, hopton wood stone, plaster cast in slabs and blocks, erinoid, bone, ivory.

While it will be well to have some squared pieces of stone for inscriptions, reliefs, and small objects, useful material may be selected from the odd pieces which are left over from large work in a stone-yard.

On Studies and Material for Carving

Drawings of (*a*) suitable natural forms and (*b*) sketches of old work should be made in preparation for designs for carving. Looking at old carving, it will be noticed that designs based on vine, rose, and oak often occur, for the old carvers found these suited to their technique and purposes. Taking a hint from this, pupils will do well to make drawings from these plants, doing them most often from memory, but from time to time making studies directly from nature. Other suitable plants are hop, bramble, Christmas rose, strawberry, winter aconite, apple, and plum. Not realistic appearances but facts of shape should be sought and recorded. The drawings may, therefore, be to some extent diagrammatic. Sections should be given where there is a change of shape. A set of simple studies which show several different views of one object—back, front, side, any view which brings out some salient form—with explanatory sections put on them where necessary, will be of more value to a carver than one highly shaded study. Drawings of birds, dogs, rabbits, and other animals should be done in the same way. The illustrations in Bewick's *Natural Histories of Birds and Quadrupeds* are good, for they give character and, by suggesting surface texture also, supply hints for the direction of tool-cuts which give life to finished carving. But intimate and affectionate first-hand knowledge of the thing to be carved is best.

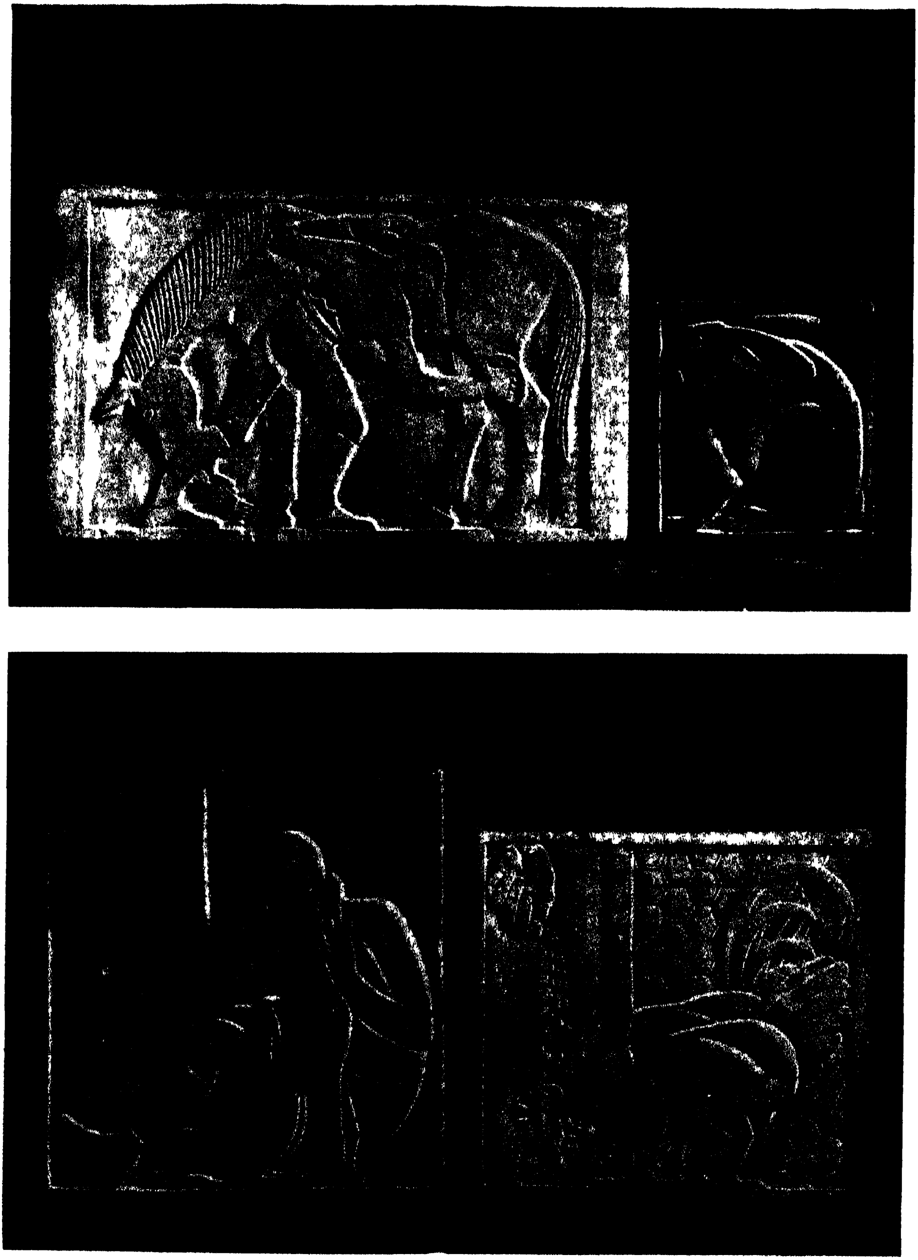
Of old work, material for study will be found in the fittings and furniture of most churches and old houses, and if the screens, roofs, stalls, pew ends, chests, and tables to be seen in the churches of Norfolk, Suffolk, Devonshire, and Somerset are within reach, there will be no lack of good material for sketching. But sketches should be done with a definite purpose, for work in hand or something to be done; they should be precise, and construction and sizes should be set down. The simple forms of carving to be found on gravestones, and on slate head stones in Leicestershire, Rutland, Lincolnshire, give hints both of design and of technique in these materials. It is possible to make rubbings of some of the simpler kinds of carving which suggest suitable work for beginners. Such work shows the value of formal rather than informal patterns, of simplification of natural forms, and of following the suggestions given by tools, materials, and use. Beginners' work usually errs by being too complicated and too realistic. It is well to have a few casts of good and typical pieces of carving. These can be bought at the Victoria and Albert Museum and are not expensive.

It is one of the virtues of much old work that the original surfaces of the plank or block are recognizable, or are partly left, when the carving is finished. It all seems simply done with an economy of cutting. In beginners' work the reverse is often true: there is no part but is cut and worried. Chip carving done by South Sea Islanders and the similarly carved and notched work done by Swedes and Danes give good hints and suggestions. In scale, sense of surface, and relation to the tools which carved it, such work deserves study. When painted in gay colours, red, white, and green or blue, it makes an admirable surface decoration. It may be taken as a principle in craft work that it is wise to stress the characteristics of a process or material. So in this type of carving it is well to emphasize the regular spacing and make a virtue of the small units and regularity, avoiding too much variety, either of surface or of pattern, for no good workman wastes his labour. Beginners should remember this, for, to obtain a like result, what one intends to do must be clear before beginning. By keeping simple shapes and surfaces the work is likely to have pleasanter texture and be less liable to fracture. The value of such consideration is well illustrated in miniature in Japanese netsukis, in which it may be seen how the original shape of the piece of wood, bone, or ivory, suggested certain forms to an alert imagination, and how craftsman and material played together to make delightful forms as pleasant to handle as to see. Exercises such as these netsukis suggest should be done in some of the harder, close-grained woods and other materials which have been mentioned. Beginning with simple surface patterns, a pupil feels his way with the problems which face a carver: the difficulties of grain, the ways in which lighting affects carving, how the colour of the wood affects it, and how, by bevelling and gentle hollows, to avoid the appearance of the carving having been stuck on to a ground.

Class Work and Exercises

The work of carving classes usually results in a lot of pieces of carving which serve no practical purpose. What to do with the exercises presents difficulties. It is best to avoid them if possible by attempting things which are complete in themselves. This cannot always be done but it may be done oftener than it is. Useless things, such as are associated with bazaars, must also be avoided. The co-operation of woodwork classes would materially help to solve the difficulty by supplying simple joinery for the framing and setting of the pieces. For the practice of some new detail or treatment, exercises as exercises must be done from time to time, but the piece in which they are to be used should be at hand as a spur to endeavour, and to be taken up as soon as possible. A good standard once established in the class helps as a live tradition.

Suggested subjects: Chess- or draught-board with stained squares between sunk lines. The border and edges may be slightly carved, or painted; draughtsmen, not necessarily round; for chessmen, see Norse



By courtesy of the Director, Central School of Arts and Crafts, Birmingham

CARVING IN PLASTER AND STONE

Nos. 1, 3, and 4 carved in plaster; No. 2 carved in stone. The animals and birds in Nos. 2, 3, and 4 were kept in the classroom.

chessmen in walrus-ivory at British Museum, or a post card of them; wall-board for brass candelabra, in conjunction with metal class. Paper-knife; spoons; apple-scoop; letter-weight; holders for ink-pots; panels for decoration round top of wainscot, each panel with a different flower or device, coloured or pierced to a background which may be coloured: these for the master's room, School Chapel, or Parish Church; panels or bands of carving to form the back of a settle, or a bed-head and foot, or a corner cupboard; panel with School or Town arms, or School device for Headmaster's Chair, or chair of Chairman of Governors. These arms, or device, might be coloured and gilt.

Small wooden platters, square or round, with shallow cuts on edges. Stands, round, square, oblong, carved on edges, on top, or with carved feet, for flower vases, flower pot, bronze figure, pottery or china figure, or plaster figure of, say, statuette of Madonna and Child from thirteenth-century ivory carving (cast obtainable at V. & A. Museum). Bread-boards, square, oblong, octagonal or flattened octagonal in shape. Alms-dish, alms-tray with handle, alms-box.

Panels carved in low relief in alabaster for surrounding a fire-place. Coats of arms, devices or pattern for space over mantelpiece, carved in wood, alabaster, or plaster, may be painted and gilt, and let in flush with the wall. Panels of inlay for decoration of chimney-piece or for boxes.

Chairman's mallet, wooden handle for a large knife. Wooden nut crackers in box or other smooth wood with engraved or slightly carved pattern. Handles for umbrella and walking-stick. Wooden mace as a trophy, carved, painted and gilded. School trophy in wood, similar, for instance, to a Roman standard: one for girls' and a different shape for boys' sports. Pointer for lantern sheet or blackboard, shaped, stained in a pattern, or inlayed with other coloured wood or bone. Set of carved handles for a chest of drawers or other piece of furniture. Four emblems—" Four corners to my bed, angels bright about my head "—symbols of Matthew, Mark, Luke, John. Candlesticks of size for altar table or high table, or of an ordinary size. Electric light standard, carved finial for a newel post —an owl, rabbit, or a tight bunch of flowers carved and painted. Carved cross to hang on the wall, or an altar cross, grave cross. Toys, animals —contents for an ark. A mascot for a car. Model boats—dug-out, punt, gig, river and sea boat. Models of old ships and rigs gaily painted. Carved picture frame, mirror frame, frame for miniature.

Models of voussoirs, skewbacks, springers, vaults, bricks of various proportions. Bowls for nuts, fruit, sweets, small trays cut from the solid: square, oblong, hexagonal, flattened hexagon, octagonal and flattened octagon, diamond-shaped, round, oval, with rims and edges vandyked, or otherwise decorated, or with the feet carved. Very beautiful shaping, rather than carving, little decoration rather than much, and very nice finish might be the aim. Bread-tray with canted sides pierced or decorated with geometrical or flowery pattern. Polished wooden cups, with or without handles.

Carving in slate, which may be gilt: sundial, arms or inscription, say, for panels for gardens and other places.

" Not God in Gardens?
'Tis very sure God walks in mine."

Think and Thank. Pray and Praise.

Inscriptions must be short, as:

James Watt, 1736–1819, lived here.

In honourable memory of Thomas Scarlett, V.C.
Sometime a scholar here.

John Hincks, thrice Lord Mayor of this
City, once a pupil here.

A verse for a beam, or for a band, over a mantelpiece. Flap and surround for *Letter Box* and *Telephone.* The lettering may be incised or raised, with or without added ornament.

Exercises with a single unserrated leaf to show it in relief, not foreshortened, on a ground: two leaves together: a narrow border of single leaves.

Exercises may be done as variants on a cast of a good piece of carving, changing its details, or the shape of the panel or space.

CHAPTER V

Crafts

Modelling

Drawing deals with linear qualities, painting with colour. Form, with which modelling deals, is less enjoyed and less generally studied than drawing or painting. Although little children delight in modelling, the appreciation of sculpture, and of things of beautiful form, rarely follows. Exercises in modelling and carving should develop these early preferences and lead to appreciation of their characteristic beauties.

Clay should be kept in a bin—a box divided into two, lined with lead, and having a lid, one part for the prepared clay, the other for that which has been used. The prepared clay should be covered with a wet cloth, and a little water put to the waste, or used clay, in preparation for reconditioning. When remixing it should be made into a perfectly even consistency, for when clay is unevenly plastic it cannot be used freely. It should be possible to tilt the tops of the modelling stands, or tables, to a steep angle and keep them firm at any slope. Each pupil will need a damp cloth or sponge and a few modelling tools of simple shapes, including a wire tool. Tools of complicated shapes should be avoided. Some laths of various thicknesses, as ½″ × 1½″, 1″ × 2″, are useful in preparing and making clay backgrounds and for other purposes.

A good way to begin with juniors is to accustom them to the behaviour of clay by giving to each a lump to make what they choose. They will probably choose to model a doll, a dog, horse, or bird, and may practise with this over several lessons, completing their models, or beginning others. Live animals should be at hand that pupils may be familiar with them, memorize their forms and check their impressions. Some photographs of Greek toy animals in terra cotta and of Assyrian reliefs—both at the British Museum—suggest the kinds of work which may be done. In this, as in other exercises, pupils will give their attention to details, overlooking main masses and construction, and it will be necessary to direct observation to the big things. Evidence of real interest, and recognition of the characteristic forms and poses in the original, are what a teacher hopes to see in these early exercises. Skill in rendering them will come with practice. These exercises will be in the round, their sizes being settled by the pupils. A successful small model may lead to a larger one being attempted. Following these exercises side views may be done as reliefs. From an outline drawn on a clay slab the background will be cut away, the salient planes cut with a wire tool from the remaining clay and finished by modelling with more completeness than in former exercises. Elementary exercises, to promote sureness of feeling for the clay, may begin with a small ball of soft clay which is pressed down to a thick button having a concave top. On four sides of this the edges may be pressed down to form a rosette to which detail may be added. Such simple exercises should be repeated until some control of hand and fingers is obtained. To cultivate surer modelling and more precise handling some exercises should be done from things of simple shapes, the forms of which are quite definite, easily apprehended, and, with effort, may be copied. Such things as the following will serve: a sphere; an egg shape—the differences between the shapes of sea birds' eggs and those of ordinary poultry, of a swallow's and hedge sparrow's, will serve for contrast; large cockle shells; a codlin and a russet apple; two pears of different shapes; Italian gourds. Casts from the shields from the tomb of Edward, duke of York, at Kings Langley, form good exercises; photographs of the badges in the bronze door to Henry VII's chapel at Westminster supply good suggestions for translations back into reliefs, as would also a restoration from a photograph of the shield modelled in boiled leather from the tomb of Edward, Prince of Wales, at Canterbury. Simple tablets recording an event, or memorial tablets, may be modelled, and plaster casts made from them. If the school can get into touch with a foundry, these or other exercises may be made permanent by being cast in lead or cast iron. A medallion with an emblem or wreath makes a good exercise. This may be modelled and cast in plaster. Terra cotta clay may be used for modelling, and after being slowly and completely dried, the exercises may be fired in a local kiln to make them permanent. The list of subjects given under carving will suggest subjects for modelling in terra cotta and for casting in lead and iron.

Gesso-work

The minor craft of gesso-work is allied to modelling. In the lower forms of relief it is applied with a brush. Bolder work is done by using cotton-wool or tow (which may be finely cut) with the gesso in building up the relief. Picture frames, mirror frames, boxes, and caskets may be suitably decorated with gesso. Properly made and applied, it is well-nigh unbreakable. It is sold in packets already prepared for use, but as some may wish to make their own, the following recipes by Walter Crane are given.

For small fine work with a brush: boil one part powdered resin in four parts of linseed (boiled) oil; add six parts melted glue; soak whiting in water till soft through, and add to above with sufficient hot water to mix to consistency of thick cream.

For rather bolder work, mix fine Italian plaster of paris with thin glue or size, to a creamy consistency, and lay on with a fine pointed brush. For larger relief work, use the second mixture, but in working take cotton wool, pull it to pieces, free it from lumps, and dip it into the plaster, then lay it on your panel and so model up your design.

For all gesso-work, whether on wood or plaster or other grounds, it is well to coat the ground with shellac. Some wet the ground, some use lime water. The great danger in gesso-work is the peeling off when dry. It may be coloured and gilded and takes polish well. While the wood ground on which gesso is often modelled takes stain well, gesso usually takes it irregularly. So a pleasing contrast is made between ground and ornament.

Linoleum and Wood Engraving, and Colour Wood-block Printing

These crafts provide opportunities for developing delicate control and imaginative work with simple tools and inexpensive materials. The limitations imposed by the materials and processes, as well as the opportunities which they offer, are valuable spurs to invention. An artist's business is to make beauty out of difficulties. The simpler forms of these crafts are especially suitable for children, for an idea can be set down, put to proof, and a result obtained before enthusiasm wanes. Simple designs and simple colour effects are best. A beginner may commence with patterns of lines only; these, cut with a gouge or graver, will print as white lines on a darker colour. Varying the widths of the gouge, different patterns can be made for diapers, panels, or borders. To such patterns of lines simple or elaborate details and foliation may be added, or parts of the ground may be cut away to give patterns of any intricacy. By crossing a number of lines at right angles and joining their ends in various ways, good patterns may be made. Albert Dürer and Leonardo drew such patterns and the early wood engravers of France and Italy used similar patterns beautifully. Suggestions could be taken from these for borders, headbands, or tailpieces for a printed page, handbill, bookplate, or stationery. Hints for further elaboration of these lace-like patterns on a darker ground may be taken from the vine-like, trailing growths of goose grass, convolvulus, wild-strawberry, ground ivy, briony, hop, honeysuckle, stitchwort. Still making light patterns on a darker ground, dried sprays of eryngium (alpine sea holly), hedge mustard, and the like may be cut, as sure and delicate cutting is possible. (These two plants are mentioned because dried their sprays are easily kept for use in the classroom; live sprays and plants such as the light and elegant linums would serve equally well or better.) Some attempts may be made to arrange these within a space. Developing the same treatment, leafless trees against a dark sky and snow in a winter landscape will give subjects for cutting as subtle as can be handled by the cleverest pupils. Some pupils will probably wish to do portraits. Beginning with profile views, these may have the background cut away and interior drawing of details of features and hair cut in white lines.

If cutting in this white-line way is delicately done on boxwood it may be printed as an engraving, black or dark on white. Stiff ink is rubbed into the engraved lines, the surface of the block carefully cleaned, and the engraved lines printed on india or similar paper. It will be seen that, beginning with the cutting of simple " knot patterns ", the same method of cutting can be followed until very difficult subjects are attempted.

The elements of heraldry also form an excellent beginning. These lead to the cutting of coats of arms with mantling and supporters, involving difficult drawing and design. The designing of initial letters and monograms with knot or foliated backgrounds makes good exercises; ornamental borders in conjunction with lettering, others. Between them pupils of a class may cut an alphabet, each pupil doing, say, three letters: the letters should be in one style and of one height. They may be used in school announcements. The filling of spaces with single figures will give more difficult problems, and the treatment of backgrounds will provide further lessons. Some exercises will be concerned with the spacing of a single or double page in reference to type.

Colour printing from wood blocks may be practised by senior pupils: it is too complicated and difficult a craft for juniors. The forms of heraldry offer good subjects for commencing this craft also, for areas of colour rather than lines are suggested by the process. The divisions of the shield, their combinations and simple ordinaries give such areas. The printing of several colours in the definite patterns of heraldry makes a good introduction to the difficulties of registration. As good examples of colour prints those of the Japanese come first to mind. Among them some of the most beautiful examples of this craft are to be found. Pupils would do well to purchase for themselves from the British Museum reproductions of *Fuji in a Storm* and *The Wave*, by Hokusai, and to look at them from time to time. But for beginners Japanese prints have a disadvantage; they are rarely built up on masses of colour, but on outlines. The outlines are often superbly cut in imitation of lines drawn with a brush. Such quality in outlines is not suggested by the process but made possible by the inimitable skill of cutters. So those designs and compositions which depend more on their shapes of colour will be found to give less trouble in cutting. Such designs may be translations of studies of flowers or fruit. Effects which minimize linear detail, and put value on mass shapes such as the silhouettes of hills and buildings, are suitable.

The materials and tools may be bought from carefully selected stocks on sale by recognized merchants. Morley Fletcher's book on *Wood-block Printing* describes the processes in detail, and a very good pamphlet by Elizabeth Field, *Colour Printing from Wood Blocks*, gives succinctly, and explicitly, all necessary information for beginners.

Bookbinding

Equipment.—For exercises in paper-folding and cardboard work for a class of twenty. 10 folders, 10 knives, 10 safety steel straight-edges, 10 zinc cutting plates, 10 pairs scissors, 6 set squares, 6 paste brushes, 20 needles. For more advanced work, forwarding—6 sewing frames, bookbinders' press and tub, plough for cutting, nipping press with pressing boards: royal 4to, 12½″ × 10″, demy 4to, 9″ × 5½″, a pair of each size; small tenon saw, glue pot, glue brushes, shears, wing compasses, dividers, band nippers, backing hammer, three pairs of cutting boards 11″, 8″, and 6″ long, and three pairs backing boards 13″, 11″, and 8″ long; gold knife, gold cushion, steel scraper, blood-stone burnisher.

For finishing—finishing presses, single line fillet, set of gouges, set of line pallets; selection of tools—leaves, flowers, and devices (these may be cut and filed by pupils); a good Roman alphabet (a useful size is ¼″ high); polishing iron; finishing stove.

Materials.—In selecting materials avoid makeshifts and substitutes. A good, but not too thick, cartridge paper, chosen to match the tone of the paper used in the book to be bound, is suitable for end papers; papers printed in colours (pupils may colour or stain these); a selection of manila papers; straw boards—surface size 30″ × 25″, in a range comprising 8 oz., 12 oz., 1 lb., 1½ lb., and 2 lb.; mill boards—" medium " 24″ × 19″, and the thicknesses 6 penny, 7 penny, and 8 p. xx; bookbinder's cloths and linens (" Bancroft " are suitable); " art canvas " and " art vellum ". These fabrics may be " blind " or gold tooled, or stencilled with damp-proof colours. Leathers: morocco, known as niger or oasis, is most useful. It is bought by the skin. Sheep skins, known as roans and skivers, if properly tanned, are suitable for cheap books. Deep English gold leaf in books of 25 leaves at from 2*s.* to 5*s.* a book, according to quality and thickness. Glaire (for gold tooling) is made from white of eggs well beaten up, and diluted with half as much vinegar. Allow this to settle for twelve hours and then strain. Bookbinders' linen thread in

½-oz. skeins—25-2 cord (thin), and 16-2 cord (thick), are useful grades. Hemp cord for " flexible " sewing in ½-lb. balls of different thicknesses. Bookbinders' stiffened tape—remnants from linen used for covering may be used instead if cut to the required width. Good Scotch glue, and paste made from wheaten flour.

Suggested Course for Juniors.—The course should begin with several exercises in paper-folding and cardboard work. The following exercises are arranged in order of difficulty, and one is given in detail. It is assumed that the teacher has some knowledge of the craft.

Paper cutting and folding, using scissors, folder and ruler.—To make a portfolio to hold papers a quarter imperial size—11″ × 7½″. For this a stout sheet of brown wrapping or manila paper 20″ × 20″ will be wanted. Measure and mark 7″, 8″, 5″ along top and bottom edges and draw vertical lines with folder and straight edge through these points. Measure and mark 4¼″ from top and bottom of each side and draw horizontal lines through these points. The two pairs of crossed lines leave a central space 11½″ × 8″. The middle spaces above, below, and on either side of this will be flaps. On the top and bottom edges of the paper, from both sides of the middle spaces, measure 1″ inwards. From these four points draw lines to the corners of the central space to give a slope to the sides of the two flaps. Carefully cut away the waste at each corner with scissors. Cut off the top and bottom corners of the 5″ flap to the right, equally. Fold in the 4¼″ flaps, the 7″ flap on the left, and finally the 5″ flap on the right to complete the folio. When taking a large class it is helpful to draw diagrams of the exercises full size on the blackboard.

To make a wallet. A further exercise in paper-folding with sides pasted up as an envelope, to hold sheets of the same size as before, 11″ × 7½″. A sheet of paper 20″ × 13″ will be wanted. Measure 7″, 8″, 5″ on the 20″ edges and mark lines as in the first exercise. Reduce the side flaps by ¾″ the 13″ way. Fold over ¾″ of centre portion. These folded pieces should be pasted and the 7½″ flap folded over and stuck. Put under a weight to dry.

Cardboard work using knife and straight edge. To make a cardboard box 8″ × 4″ × 1½″ deep to hold a pupil's small tools. Cut a piece of lined 12-oz. straw board 11″ × 7″. The angles of this must be perfectly square. With compasses mark off 1½″ all round. Score along these lines with knife and straight edge, then cut out the waste pieces from each corner. Fold up the sides along the scored lines, and bind corners with strong binding tape folded into half width. The lid is made in the same way. Cut cardboard 11″ × 7″. Mark 1⅜″ margin all round—this ⅛″ less allows for thickness of card. Score along lines, and make up as box. To bind edges of lid cut two pieces of binding tape 8″ long, and two pieces 4″ long, fold in half and cut to mitre at corners. Box and lid should then be covered with paper which may have printed decoration or be plain and decorated by hand. Labels should be put on both ends of the box for the pupil's name.

To make a needle case. Cut two thin pieces of straw board 3″ × 2″, cover with bookbinders' linen, allowing ½″ between the boards. Line inside with paper and sew in one or two pieces of flannel in the middle of the case. Calendars, photograph frames, blotting pads, sketch blocks, work holders, make suitable exercises; others will suggest themselves as the work proceeds.

Early exercises in bookbinding might include: the sewing of single sections into paper covers, making a single-section note book with stiff covers, the binding of a piece of manuscript in quarter linen or paper, binding school survey books, sewing on tapes, glueing up, cutting edges, rounding and backing, making linen cases, putting book into case, pasting down.

Suggested Course for Seniors.—First exercise. The rebinding of a text or library book in full linen—split boards. A book is said to be bound when the cords or tapes on which the book is sewn are laced or fixed into the boards and become part of the binding. It is cased when the cover has been made apart from the book and is only held to it by pasting the mull and end papers to the boards.

The processes of rebinding begin with taking to pieces or " pulling ". The boards must first be detached by cutting the mull and end papers down the joint. Each section should be opened in the middle and the thread cut. Pull the sections away carefully and clean glue off the backs, keeping them in their proper order. If the book has been " backed " this must now be knocked out. Take a few sections at a time and tap gently down the crease with a smooth, round-faced hammer. Any weak or torn sections must be mended, the first and last sections usually need repair at the back. Before sewing the book should be collated—the " signatures " must follow consecutively. End papers should be folded round the first and last sections and the book sewn on three tapes. The next processes are gluing up, cutting edges, rounding, backing, squaring and fixing split boards, lining back, and covering.

Further exercises which may be done include work with guard boards (one guard to a leaf) for mounting photographs, library books sewn " flexible " on cords and covered in quarter or half morocco with linen sides, full leather books with hand-made head bands, and colouring and gilding edges.

The operations involved in lettering the title and the decoration of the book by stamps are called finishing. All books should be lettered whether decorated or not. The decoration should be ornamental, not pictorial. Simple designs without shading look best. The tools used in making the designs should be simple in shape so that they will bear repeating. They can be grouped or distributed on a geometrical plan with borders. When it is used, lettering should be considered as part of the design. Construction should suggest the scheme of decoration. Decoration begins with the spacing of the bands in sewing, and appearance and decorative values should be considered in all subsequent processes.

Progressive exercises in finishing might include: setting out a title with hand letters; a simple pattern with lines only for the side of a book; a pattern with lines and dots for the panel on the back; making an all-over diaper with simple tools; working some of the above designs through the paper on to the leather for blind tooling. (If the designs are worked on squared paper—about 10 squares to the inch—much time is saved in setting out.) Gold tooling and lettering; pasting down and finishing.

During the course, lessons may be given on the origin of the written and the printed book, the manufacture of parchment, paper, boards, leather, and other materials used in the craft. The following books are recommended: J. S. Hewitt Bates, *Bookbinding for Schools*; Douglas Cockerell, *Bookbinding and the Care of Books*; J. Kay, *Bookbinding for Beginners*; R. W. Sindall, *Manufacture of Paper*; Parker, *Leather and its Manufacture.*

Spinning and Weaving

Hand-loom weaving is now widely recognized amongst educationalists as one means of teaching a sound craftsmanship which involves the fundamental principles of art. Hand spinning and dyeing with vegetable dyes must be included as parts of the craft if the best results are to be obtained. The beautifully harmonious colours produced by using vegetable dyes, the quality and interest of texture given by the hand-spun wool, cotton, or silk, and the good pattern easily obtained, make it of the first importance to keep alive a handicraft which is so well adapted to maintain a high standard of taste and quality liable to be lost under industrial conditions. The practice and study of this craft helps to develop a knowledge and appreciation of good workmanship, stimulates creative abilities, and brings a greater intelligence and a finer discrimination to bear on the selection of textiles of every description.

Courses similar to those here outlined can be easily adapted and followed in elementary schools, secondary schools, and colleges. The advanced stages of the craft are best acquired in the workshops of a practical weaver, or in schools and colleges where proper workshop methods are taught. Much disappointment may be caused, and discredit brought upon the craft, if a defective and ill-taught course is pursued. It is therefore essential that it should be taught only by those who have been well trained and are fitted to bring their students to a high standard of attainment and artistry. During the course short talks illustrated by examples or lantern slides should be given on the following subjects:

1. Raw materials used in spinning and weaving—animal and vegetable—their character and suitability to various uses.
2. Spinning. Hand-spinning on spindle or wheel. Spinning by machinery.
3. Looms. Primitive looms. Looms of the middle ages. Modern looms.
4. Woven fabrics of various types, styles, and periods.

The order in which these are taken and the standard reached must depend upon the type of student and time available. A spinning demonstration on wheel or spindle and a talk about wool should be given early in the course, and whenever possible students should be taught how to make a continuous thread from the short fibres of wool, cotton, silk, or flax. Of these materials wool is the easiest to spin and takes the colours of the vegetable dyes most readily. Spindle spinning is the most handy for class teaching, and spindles in plain white wood can be obtained at small cost. In using the spindle the pupil will gain perfection in the art of spinning and gradually collect enough yarn for use in the later exercises of the course. Hand-spun threads give greater richness and beauty of colour and texture than a machine-spun yarn. The latter, however, is more easily handled by a beginner on the small braid loom; it is, therefore, advisable to use a good 2-ply fingering (machine spun) until some degree of proficiency is attained.

Equipment and Materials Required.—Spindle and Dryad braid loom with 5½″ heddle for each student. Fleece (good English " matched fleece ", medium staple). 2-ply best fingering (scoured but not dyed). Dye-stuffs and mordants. (See Dryad leaflet, No. 26.) Scissors, tape measures, needles, pins, notebooks, squared paper, crayons, pencils, &c. French canvas and coloured linens for the making up and lining of pochettes, bags, &c.

It is not possible to give here a detailed description of the methods of spinning and weaving. A knowledge of the craft is presupposed. There are many excellent textbooks on the subject, some of which are mentioned on p. 276. Diagrams and full instructions for use are issued with the " Dryad " looms.

The following exercises are only to be regarded as suggestions for teachers. They are graded and planned in such order that, with the help of talks and demonstrations, students will have opportunities to learn something of the history of their craft, and of colour arrangement and pattern-making, whilst they are overcoming the difficulties of technique. For all weaving exercises each student should be allowed to select, from a stock of yarns, few or many colours to form a desirable scheme. Some find it helpful to plan out their designs on squared paper with coloured crayons, but this should not be enforced; the most spontaneous patterns are usually the most delightful.

Exercise 1.—A braid about 2″ wide to be woven in plain " tabby " weave. Colour of warp to be of medium tone, that of weft either darker or lighter, if not of a contrasting colour. Stripes of other colours may be introduced at intervals in pleasing proportions. Tabby weave should look like darning, showing equal proportions of warp and weft, hence the desirability of having light and dark threads for warp and weft of first exercise, in order that faults in tension may be easily detected. If a student finds the technique very difficult a second braid in plain tabby should be woven before going on to the next stage. Stripes in warp as well as weft, giving a plaid or chequered effect, would make a pleasing variation.

Exercise 2.—Still using tabby weave for ground, but having warp and weft thread nearer in tone or colour than in previous exercise, make patterns across width of braid by (*a*) holding heddle up or down whilst throwing three or more threads in same shed, keeping them in place by passing shuttle round outside warp thread on either side. This may be repeated any number of times by reversing position of heddle or by weaving a few rows of tabby between the thickened lines produced in the way described. (*b*) With raised or lowered heddle weave shuttle in and out of top threads, reverse heddle and with some of contrasting colour throw one plain row; repeat this not more than four times or loose warp threads will appear at the back. This must be avoided when both sides of the weaving are to be seen, as in scarves. (*c*) Keep warp threads flat and use heddle only for beating up weft. (1st row.) Weave shuttle over and under groups of three threads. (2nd row.) Change colour and weave under warp threads covered in previous row and over those left exposed. Repeat this until a row of squares or oblongs has been formed, when, by reversing the colours, a chequered pattern will be formed. Endless variations of this can be made by weaving in and out of the warp threads in any order. The rows need not always follow each other on the same set of warp threads but can be worked diagonally, thus forming diamond patterns and other more complicated shapes. It is not advisable to go over or under many warp threads or the pattern may appear loose and clumsy. Both sides of the fabric should show a good tidy pattern. This method gives a thick beaten-up appearance like tapestry. The same pattern woven with a tabby ground of the second colour will look lighter and flatter.

Exercise 3.—Some "brocading" may now be tried. More complicated patterns are designed to be built up on a tabby ground in any form consistent with the warp and weft threads, either by weaving over and under groups of warp threads in one colour on a tabby ground of another colour, or by laying pattern threads in with ground thread, making a double weft of two colours where pattern is desired. These methods are generally used to obtain spotted effects. Woven patterns of Egypt, Persia, India, Norway, Sweden, and other countries should be studied. This third exercise may be designed for some special purpose such as dress-trimming, pochette, bag, blotter cover, &c. Afterwards, wider bands may be attempted designed for similar uses on a larger scale, and also for cushions, tea-cosies, caps, bonnets, &c.

This will lead on to the senior course where looms with 15″ heddles, and rollers capable of taking three or four yards of warp, will be used. Here the first exercise will consist of learning to make a warp on a "warping board" and set up the loom ready for weaving. Many articles can be woven on looms of this size. Scarves, runners, cushion covers, table centres, material for children's dresses and suits, and even skirts and jumpers for older people. Hand-spun wool may now be used for wefts, and if very evenly spun and plied, for warps also. Where there are " table looms " or larger " foot power " looms, treddle patterns using four or more heddles may now be attempted and a greater variety of materials used. Tweed suitings, dress materials in silk or cotton or wool, also household furnishings, such as curtains, cloths for various purposes, towels, runners and rugs plain or patterned, may be made in endless variety.

Further details can be obtained from the following books: J. A. Hunter, *Wool*; R. J. Peake, *Cotton*; Luther Hooper, *Silk*; Alfred S. Moore, *Linen*; M. L. Kissell, *Yarn and Cloth Weaving*; E. Mochrie, *Simple Weaving with Patterns and Suggestions for its Use*; Luther Hooper, *Weaving with Small Appliances*; *Table Loom Weaving*; *Weaving for Beginners*; *Hand Loom Weaving*; E. F. Worst, *Foot Power Loom Weaving*; Dryad leaflets.

Lettering

Tools.—Steel pens, round pointed for skeleton letters and for exercises in spacing, square and oblique ended, parcels pens up to about one inch wide (" adascript " parcels pen — Royal Sovereign Pencil Company's, Wolff's, or Mitchell's make), bamboo and reed pens, punches and engraving tools and chisels for linoleum, blocks, plaster and metal grounds. *Materials.*—Papers and cards of various colours with suitable surfaces, foolscap for practice; " Whatman's " hot-pressed and dover mill papers and vellum; plaster slabs, wood, slate, and thin metal for incised, punched, engraved, or gesso letters; black and coloured inks, colours and white, poster colours; blackboard chalks—ordinary, square, and of oblong sections.

The following is a good order for the exercises. A junior course should deal with numbers 1, 2, and 3; a senior course with numbers 4, 5, 6, and 7. It is well if all exercises are spaced and arranged on the same sized sheets, each making an orderly and pleasant whole as old embroidery samplers were arranged. (1) Single-line Roman capital and small letters made with a round-pointed pen. These may be written on foolscap until the proportions of the letters are grasped. Spacing of the letters will be part of the practice. Diagrams for setting out lettering on single sheets. (2) Practice with simple slanted-pen, letters based on Roman capitals. This may be followed with a quotation filling a panel to give practice in forming letters and word spacing. A simple border may be added. (3) Free uncial letters written with a No. 1 or No. 2 slanted pen. Half uncials. For exercises, a quotation to fill a shape—a circle or oblong. (4) Italic capitals and small letters, with quotations to give practice with them. Diagrams for setting out lettering in book forms. (5) Built-up Roman letters and numerals. (6) Brush forms. (7) Decorative border forms.

Subjects for Exercises.—The following list gives suggestions of subjects for exercises. The simpler subjects suitable for juniors are put first, but with many of the subjects suggested either an elementary or advanced exercise may be made. A child's alphabet illustrated—A is for apple, B is for bee. Book plate for pupil's own books, or for the school's books. Visiting card or business card. (Blocks for printing these may be made from the pupil's lettering.) Name plate. " Inquiry office ", " IN ", " OUT ". Christmas cards with quotations. Loose cover for a borrowed book. Simple inscriptions. Labels for jars, as rice, flour, and for boxes with suitable inscriptions as decoration, e.g. " Who chooseth me shall get as much as he deserves "; " For (Pandora) on her birthday ". Monograms, cypher, cypher reversed as a personal mark cut in linoleum or wood-block, or for embroidery or for saw-pierced buttons (to be made in metal-work class). Sports and school badges. Badges for Hospital Saturday, Life-boat Day, Red Cross Day. The initial of the city or town's name with its motto below and crest above. Rose with motto " England ", or thistle and " Scotland " and shamrock with " Ireland ". St. George's cross with " Saint George for merry England " beneath. Labels for plants and trees with Latin and common names, place of origin, &c.

Subjects more suitable for seniors: Lettering for school banner, or for record of scholarships. Church hymn board. Menu. Initial letters and decoration of a finely *printed* page. Inscriptions, engraved slabs or lettered boards, for instance: " William Morris lived here from — to —." " On this spot stood the West Gate until 1870." " (Leighton) School Cot." " Of the parish of — in the County of — these served the King in the years of Our Lord MDCCCCXIV–MDCCCCXVIII." " In gratitude to God for the loving kindness and the sincerity of — who died — ." Street name plate. Inscription for a clock face. Inscription for a building, or to place over the door of library or canteen. Memorial brass. Cover for parish magazine, title pages, chapter headings, lettering on maps and plans. Family trees and pedigrees. " Notice board." School notices and notices for charitable purposes, notices regarding litter and public amenities. Temporary and current school notices well spaced and beautifully written with " square " chalk on a board (pupils of the senior class may do them in turn). Name of house cut in slate, plaster, stone, incised with a tracer on thin brass, or painted on wood, or lettered in gesso. A set of numerals to illustrate maximum legibility at longest distance for cricket scoring-board, or motor-buses, tram, and motor-cars. Certificates.

For junior or senior courses: quotations, prose, verse, prayers. The spacing and arrangement of poetry, having regard to appropriateness of style of letters to matter, for instance, uncials for passages from the Bible, italics for verses from Herrick. Complete panels of lettering, using colour in initial and capital letters or in borders. Small books of prose or verse, using an alphabet which has been studied. " Whosoever thou art who enterest this church, leave it not without a prayer for thyself, for those who minister, and for those who worship here."

From time to time as lessons in practice proceed, the following matters should be dealt with. They can be admirably illustrated by slides which may be borrowed from the excellent collection at the Circulation Department of the Victoria and Albert Museum, and pupils other than those who are practising lettering will find these very well illustrated lessons valuable. Suggested subjects: Inscriptions in various materials, stone, wood, metal; tools; influence of materials and tools on lettering and its treatment; position: treatment for lighting and distance; methods of planning and spacing, uses of inscriptions, standard examples, study of old work, numerals; relative weight of different alphabets, black on white, white on black, colour on colour.

Books for quotations and inscriptions: Any good Anthology; *The Golden Staircase*; books of verse for children; G. F. Hill, *On Medallions*; Benson, *Lest We Forget*; *Inscriptions suggested for Memorials*; Bridges, *The Spirit of Man*; Swinburne, *The Year's Carols*; W. Morris, *A Year's Months*; Shakespeare Songs; The Bible; Select Masterpieces.

Some lessons in framing and in the use of passe-partout should find a place in the course. Avoid using trade advertisements as quotations or for exercises.

Values of Various Crafts

Those crafts are best for schools which have age-long tradition behind them. The wood and metal crafts, weaving, dressmaking, carving, and modelling, pottery-making, printing, and bookbinding are among these. Where a craft has answered men's needs and pleasures for centuries it presents a body of work which, for variety of invention, treatment, and range of uses, may be as wide as human needs and interests. Reason, forethought, skill, imagination and criticism have played their parts. Such crafts still offer fresh opportunities for thought and experience.

Some unworthy " crafts ", having no educational value and unfortunately associated with bazaars, have crept into school. There can be no " new crafts for schools " comparable with the old ones which are part of our rich inheritance. Neither is it a fair trial of ingenuity, or a spur to worthy endeavour, to offer for craft exercises odds and ends of material and uncomely scraps. The requisites of good craftsmanship, honesty, well-directed skill, and a worthy aim which implies our very best, are not invoked with such materials.

CHAPTER VI

Drawing

Dealing with the teaching of drawing and painting under various heads suggests a division of subject-matter and separation of interests which do not exist. This way is followed for convenience only. In practice there are no such boundaries, and to make them would be foolish and harmful.

Drawing from Natural Objects

These have taken the place of " copies " for very good reasons. Reasons for avoiding formal " models " are given in the notes on object drawing, p. 260. These apply equally to copies. The beauty of natural objects, their complex and subtle forms, are almost impossible to delineate. But the effort which springs from interest in and appreciation of their loveliness, and which tries to give a sensitive rendering of it, is worth more in its failure than success in copying a copy. The choice of subject is the teacher's, and that should be chosen which most richly serves the imagination, develops sensitive skill, and fills the mind with loveliest images for refreshment and inspiration. Capable and sympathetic teachers will recognize sincere effort in partial success, or even in failure, as certainly in drawings from beautiful things as in drawings made from copies.

It may be well to recall briefly the old course of drawing from copies, and its aims. Thus, for " Standard one—to teach the use of rulers, for drawing certain angles and curves. To teach the use of set squares for drawing and measuring lines. To exercise the hand and eye in drawing similar forms without their aids. All these exercises to be worked on slates." The course proceeds with exercises of a like mechanical kind. As training for draughtsmen it is inflexible and very narrow: exercises such as these must inevitably kill a nascent artist; for children at their most imaginative and impressionable age the course is deadly dull, barren of interest, and mind-killing. If the things of beauty which have taken their place are presented with knowledge of children and of the limitations of classroom practice, the drawings made may be surprisingly good.

Memory Drawing

The variety of things which has taken the place of copies is limited by practical considerations, but if memory drawing is rightly used, all lovely things may be brought into service. Drawing from memory has many things to recommend it. Most important are its value in training the visual memory, so making it possible to see a thing when it is no longer there, and the opportunity which it gives for keeping alive and strengthening the creative faculty. The effort to remember strengthens the impression which we are careful to check and refresh when an opportunity occurs.

Again, when a drawing is the result of a mental picture, the parts of it usually have a unity and rhythm which it is difficult to include when a drawing is composed part by part. What we remember we have usually made our own. Memory drawing makes literal and photographic representations secondary to individual preferences. Continual practice in imitative drawing alone makes creative effort difficult, and well-nigh impossible in the end. And, as a consequence, the freedom and zest with which children try any subject which interests them, dies away before the false standard of value which they give too early to technical correctness. Memory drawing helps to keep a balance of values.

The following exercises in drawing from memory are suggested by the successful practice of Mr. R. Catterson-Smith. What he has written on this subject should be in the hands of all teachers of drawing.

For both junior and senior classes, the following is a good method. The pupils are asked to draw from memory a thing which they know. It is important that they should have a clear mental picture before beginning to draw, and so, as is often done when trying to remember, the eyes are closed to shut out distraction. The mental picture may be made clearer by tracing it in the air and by handling the object. When the pupils can see the thing in their mind's eye they then draw it without opening their eyes. Having made this shut-eye drawing they then make, with their eyes open, a second drawing of what was their mental picture. It will often be found that although this second drawing is without the obvious mistakes—bad shots, which are almost inevitable in a shut-eye drawing—the drawing made with eyes closed has more spirit and movement. It has qualities which teachers come to recognize as due to visual memory rather than to reason and unpictured knowledge. The object drawn is then shown, and after carefully observing it, and comparing it with their drawings, the children make another drawing from memory. Pupils will do well to shut their eyes and endeavour to recall a sharper and clearer mental image, again and again refreshing and strengthening their visual memory by close observation of the object, so that they see it clearly in their mind's eye before making the drawing. In comparing the drawings with the object it is well for the teacher to refer to matters of general shape, proportions, pose, and character, and to avoid suggesting a special way of drawing or making a criticism of details. When the third drawing is made the object is again shown and drawings are compared with it. If it is desirable a fourth drawing is made direct from sight at a later lesson. The teacher gives instructon while this is being made.

To recall a mental picture often requires considerable effort. Some pupils find it harder than others. If pupils sit close together, the concentration necessary may be difficult, and there may be temptation to profit by a neighbour's drawing. As it is of the essence of the matter that a pupil should give his own mental picture, be entirely faithful to it, and carry the drawing or painting as far as memory will serve, it is well to space out the pupils' desks. This, besides giving each pupil a better chance, gives to the teacher necessary and easy access to all pupils.

Practically all the things which have been suggested for the equipment of the art room are suitable as subjects for exercises in memory drawing, and many are suitable for painting from memory. A memory exercise may begin every drawing lesson, and, in one form or another, may often profitably take the whole lesson period. Pupils will usually begin such a lesson, as was suggested above, with close observation of a thing, and with efforts to memorize its appearance. When a mental image can be recalled, a shut-eye drawing follows, and this is followed by a separate one, done with eyes open, which corrects obvious errors in the first drawing. The object to be drawn may be simple or difficult. Juniors may draw leaves of simple shape: leaves of various lanceolate forms may be set side by side to induce the habit of making comparisons, finding similarities and diversities. From simple leaves to those of complex shapes there is a wide range of lovely forms for practice suitable for junior or senior classes. Shells of various shapes offer another group of fine forms. Tools and utensils give other shapes, grasses and foliage others. Very simple sprays of foliage can be drawn profitably from memory, but for shut-eye drawings they are not suitable. The value of memory drawing is obvious when animals and birds are to be drawn. These supply admirable exercises.

Drawing the figure at rest and in action also provides good exercises. The figure at rest may be a pupil looking out of a window, leaning over a bench to look at something, reading, listening: a pose with some interest. The action may be comparatively still, as pushing at a closed door, or with more movement, as bending to pick up a ball, or with vigorous movement as in throwing a ball. Poses may be taken in this order. The action must be purposeful, real, not imitated. Some of the drawings will show lively suggestion and rendering of the pose or action. Others will be feeble and stiff, lacking in sensitiveness, and wrong in pose and proportion. Something may be done to correct these if the pupil himself takes the pose, or vigorously repeats the action, noticing the pose, swing, or thrust which are necessary, for beginners' drawings are usually stiff and straight, and lacking in lissomness and variety of movement.

The exercises in drawing and painting which are given to teach an adequate technique, exactness of observation, and to lead to a well-stored memory—the drawing and painting of tools, objects, buildings, natural things, singly and in groups—will be varied with other exercises to give wider training to the creative imagination. In this direction it is well to take a suggestion of subject from pupils. The teacher may suggest one, or, by reading a story, poem, or fable, prompt a drawing as an illustration. It is, in the main, desirable to keep to the realm of a child's experience or to such subjects as may be imagined from that experience. When historical subjects are given, every endeavour should be made to show pictured material from which a scene may be reconstructed. But subjects which give rein to fancy should be given from time to time, such as Autumn, Spring, Fire, Peaseblossom, Mustardseed, Speed, Courage.

One of the best ways of training the memory and also the invention, and at the same time bringing before pupils many beautiful things, is by the use of the lantern. This is a neglected method. Its use in drawing lessons is stimulating. The subjects used can be very beautiful and very varied.

Object Drawing

There are few occasions when a well-made and interesting object will not serve for a lesson in drawing better than a formal model. Geometrical models have their uses as type shapes to which many things of similar form may be referred: a way of drawing one shape is seen to be adaptable to many; models show light and shade clearly because they have no local colour and are usually white. But interest and beauty, the things of most value in subjects for drawing lessons, are absent from them. They have no character which makes drawing them worth while. They are too small to show clearly to beginners the changes due to foreshortening and perspective. These changes in appearance must be taken more or less on trust. Their handiness prompts their constant use in one position, and as a consequence practice is reduced to drawing similar views of things of one size. Their use leads to rules being seen instead of things, and to the study of rules for their own sake. It is dangerous to give lessons in the science of perspective until a pupil can draw. The drawing of a box may mean merely the fixing of the eye-level, and the drawing of certain lines converging to a point, not knowledge of the box and a desire to convey interest in it to another by intelligent use of lines. Interest and a clear mental picture are the first requisites for a good drawing, which should begin with the main shape, not with details. Corrections should refer to the general effect, not to errors in perspective. Interest and expression must come first, grammar may be needed later. Many common out-of-door things show the effect of perspective and foreshortening in a striking way. A door or a casement window, which opens vertically within its frame, is one of the handiest things for demonstration in the classroom, A window or a blackboard, which swings horizontally within its frame, shows the change of appearance the other way. If a vertical rod, marked with equal black and white divisions, is put before several things of a like kind which stand behind each other—desks, flower pots, chairs or the floor boards—their diminishing size as they recede is seen on the rod. When knowledge upsets the evidence of sight (and it is difficult to avoid this bias), it is usual to measure a foreshortened thing with a pencil held between the eye and the object. It helps beginners to realize effects of foreshortening if the surfaces of an object are of sharply contrasting tones or colours; the *amount* of one colour as compared with another calls attention to differences of shapes.

While it is inadvisable to confine lessons to a list of objects or to an arranged sequence (for interest and opportunity may prompt a departure from what was arranged), the problems of draughtsmanship should be taken up in the order of their difficulty. The following suggestions and lists have this in view.

Junior courses: flat objects, as a palm-leaf fan, shears, fiddle hung flat; straight-lined and rectangular objects, as a hamper, chest of drawers with some drawers open, clothes-horse, open door and window, deck chair, easel; cylindrical objects, as jars, milk can, oil drum; objects made up of parts of truncated cones, as tun-dish, tin candlestick, bucket; other round objects, as bowls, cups and saucers, bread basket, barrel, football. These will be drawn mainly below the eye-level. The objects of simple shape may be tilted, but others will stand upright.

In addition to drawing from objects, drawing from simple plans and elevations, drawing objects from dictation, and completion of drawings partly done form good exercises. Objects which are of contrasting shapes and sizes are good to give to beginners—a bat and ball, ladder and bucket, plate and spoon. The shape of the drawing paper, or the way the drawn objects are placed on it, may constrain the drawing, and thus the proportions of the drawn objects will be unwittingly influenced. To help beginners to realize mass shapes, and changes in them, it is a good plan to hold an object (say a tea cup or book) between them and the light and turn it about slowly, or its shadow may be cast on a blind so that only its silhouette shows. If the mass shape is drawn from this, its interior lines may be added from memory. Drawings should be made in pencil and, as the subject suggests, coloured with water colour or lightly shaded.

Senior courses: the objects suggested above in various positions, upright, sloping, and in groups placed above or below the eye-level. Add to these some more difficult objects such as a pair of steps, a blackboard which revolves in a frame, wheelbarrow, wagon, fiddle lying flat or tilted, an open umbrella, things of oval shape such as an oval milk or hot-water can, interior and exterior views of the school with its furniture and fittings, views of the staircase and corridors, groups of simple buildings and views of streets; drawings from plans and elevations, drawings from dictation and the completion of drawings partly done. These may be made in pencil, pen and ink, shaded or coloured with water colour or pastel.

Because drawing from objects cannot be the most interesting of drawing lessons, but must be practised often because of its great value, it is well to vary the way of approach as much as possible. The following are good ways of doing this with both juniors and seniors.

Drawing from Plans and Elevations.—The teacher puts on the blackboard a sketch plan, and one or two elevations as may be necessary, of an object or group, indicating a position and height from the ground from which the drawing of the subject is to be made. For instance, the plan is a circle with a horizontal diameter; the elevation is a rectangle finished above with a semicircle. These represent a milk can with its handle. Make a drawing of it when standing to one side about six feet away. Add rims top and bottom, fastenings for the handle, hang a pint measure from the lip of the can, and draw the lid leaning against the can.

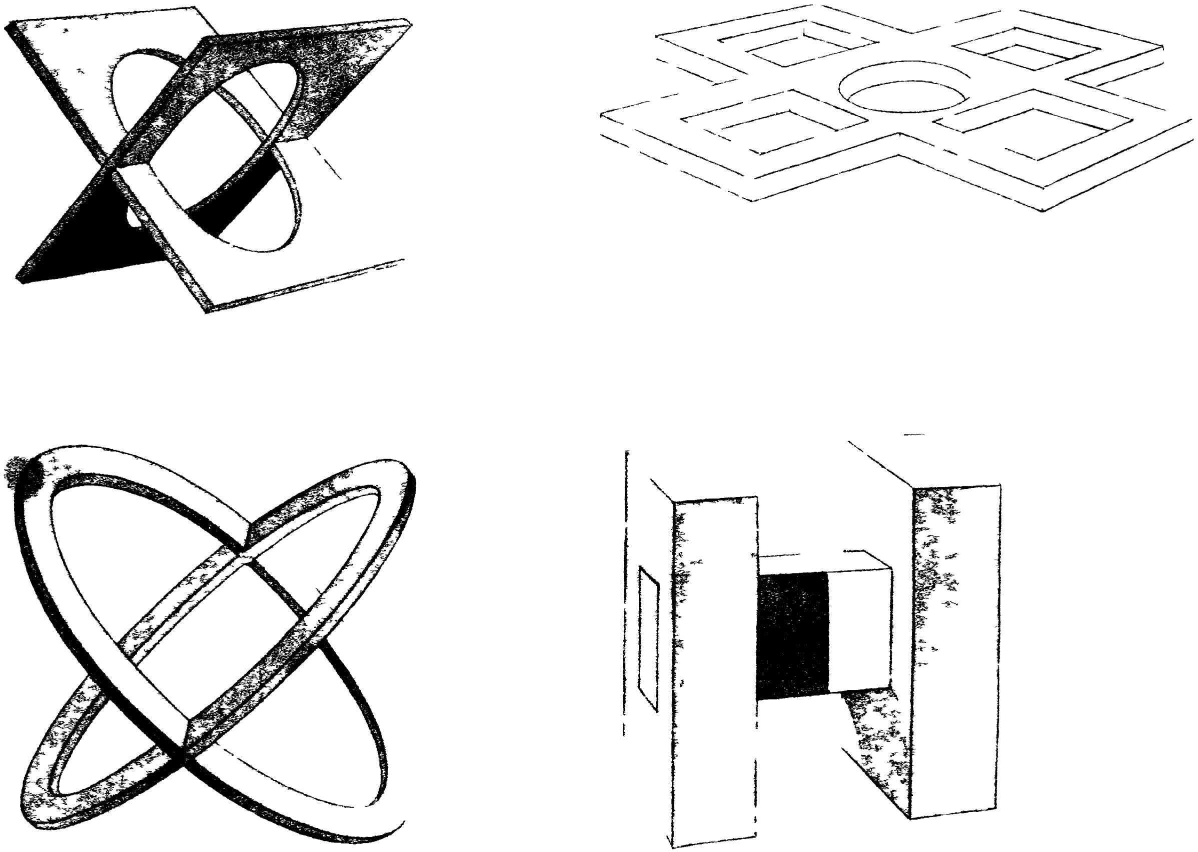
Or the subject may be a stone cattle-trough, the plan of which is an oblong. At the end of this is a square of the same width representing a post to carry the spout. Diagonals on the square represent a pyramidal top. The elevation of the trough is an oblong of the same size as its plan. The post is double the height of the trough. Its pyramidal top is an addition to this height. Make a drawing from a point to one side about ten feet away, put in the spout, the thickness of the trough, and arrange an overflow, and put a pavement of square sets all round. Add a dog or a horse drinking.

Drawing from Dictation.—Exercises to suggest what is meant. Draw a round, shallow dish, and put oranges in it which show over the rim. Now imagine the dish to be made of glass. Complete the bottom as if you saw through, and complete the drawing of the oranges. Does this completion show that the first drawing was inaccurate?

Draw a cube and cut out one quarter, or one eighth, or, supposing the cube to be a packing-case, show the boards of which it is made and tie it up with ropes crossing at right angles the middles of all sides. Or a tall square finger-post, fifteen feet high, stands on three circular steps. Draw it showing two sides of the post and " hands " pointing four ways. Or, draw a Greek cross made of wood of a square section, join, and pierce the arms with a circle of wood, square in section. Or, draw a sphere and pierce it with square bars nearly as wide as the sphere. One bar is to be vertical, and two horizontal and at right angles to each other. Show the ends of the bars and how the bars pierce the sphere.

Another way of varying such exercises consists in drawing a part of an object on the blackboard and, asking the class to imagine the remainder, make complete drawings. For instance—two lines are drawn which meet each other at an angle, acute or obtuse; one of the lines may be vertical or horizontal: these represent two sides of a cube or square box. Complete the cube or box. When three lines are given the problem is easier: when none of the lines is vertical or horizontal the exercise is not so easy. The objects suggested may be above the eye. Such brief exercises may be played as a game to fill a short interval, and to quicken imagination. They may be elaborated to fill a lesson period. Pupils should be asked to add a setting from memory to objects drawn from sight, or to add other associated objects.

Foreshortened Circles and Curves.—The following devices are used for teaching the drawing of foreshortened circles and curves. For simple exercises with circles: a broom stick with a disc, about 2′ to 3′ diameter, cut from plywood and fixed to one end, and other discs of the same diameter slipped along the stick. These may be wedged at any place on the stick. If the stick is set upright it gives practice with horizontal circles; put horizontally and turned about it gives practice with vertical



DRAWING FROM DICTATION

circles. When the discs are painted in contrasting colours different degrees of foreshortening are clearly seen.

The S-shaped, ribbon-like handle of a tin measure gives more difficult exercises when the measure is turned round and the handle drawn from different angles. Handles in many positions may be drawn on to one drawing of the measure.

For exercises of further difficulty, a simple leaf, as laurel, magnolia or the like, may be given. Its stalk is put into a penholder which is held vertically, or the leaf is fixed in some similar way, so that it may be moved round horizontally as the hand of a watch and drawn when pointing in any direction.

Cylinders.—It may be well to deal a little more in detail with two problems which arise continually in drawing from objects. First, in the drawing of cylindrical objects the axes of which are horizontal or inclined, an endeavour should be made to set down the mass shape, its length, breadth, and character. These may be emphasized by selecting an object and background which are in strong contrast with each other—white on black or dark on light—a contrast which will emphasize the mass and draw attention from details. A simple cylindrical object should be used for these early exercises, and attempts should be made to draw it in many positions *without the aid of formal methods*, so that the eye may be led to see the changes in shape which it assumes when it is turned about. The changes in shape of the ends of the object, from a circle when the axis points to the pupil, to a narrow ellipse or a straight line when the axis is turned parallel to the pupil, will also be brought out so. After making in this way as good drawings as possible, the inclinations of the axis, and of the parallel or tapering sides, should be more closely considered. If a stick can be threaded through the object as its axis, this will make clear its inclination, and the related sides of the object can be adjusted to it. (An axle or shaft carrying wheels makes clear the direction of short lines parallel to it.) The broom stick and discs mentioned above will be used in this connexion. A cylindrical glass jar, jug, or tumbler forms an admirable model at this stage. The circular bottom may be coloured to emphasize its relation with the top. The overlap, or distance apart, of the circular ends will be seen through the glass, and the places where the outlines of the sides join these can be fixed. This is important. It will be seen that these places are on a line at right angles to the axis of the object. Corrections may be suggested in the drawing if it is turned about until the axis of the object is vertical, for the drawing should be symmetrical on the axis and rarely is. It is usually necessary to complete the drawing of ellipses of which a front part only is seen, as the invariable tendency is to flatten these ellipses. Even though they are not completely drawn the ellipses must be " felt " completely round so that their relation to each other is parallel planes, and in gradually increasing roundness, may be made certain. In the foregoing suggestions simple cylindrical objects have been in mind. Objects having shaped sides more and more varied in outline will be introduced as the course proceeds. The principles of drawing them will be the same.

Handles.—The handles of certain common objects used in the foregoing exercises present a second difficulty: the foreshortening of varied curves. This has already been touched upon, and perhaps the best formal exercise for dealing with these is that already mentioned, namely, to draw a handle in profile on either side of the drawing of an object, and, on an ellipse given by the track of the handle as the object is turned round, draw the handle again in various intermediate positions. The third and fourth views should be those in the middle front and back. The heights of the salient parts of the handle in the various views can be checked from these. If the handle is made from a ribbon of metal it is well to draw the near edge of it carefully; the farther edge is added as a parallel line. The way to deal with the edge which disappears may be seen by playing with a line which has many sharply round and bending curves. Draw any such line and consider it as one edge of a ribbon, and draw its fellow edge as a duplicate line to follow the first but moved on a little. Short, straight, tangential lines will then be drawn to touch the pairs of curved lines where they sharply bend in unison, and the little pieces of line rubbed out which lie behind the web of the ribbon. The ribbon may be shaded to make its bending clear.

Light and Shade

In an art room, usually lighted with somewhat diffused and general light, the effects of light and shade are difficult, complicated, and undecided. As a consequence, striking and simple effects which should be considered first, and lead to the understanding of difficult ones, are rarely possible. Clear and definite light and shade may be secured for a few members of the class, and pupils may use in turn the few positions where this is possible. It has been assumed that the drawings which have been suggested would often be shaded. Such shading will generally be carried as far as is necessary to explain the drawing and will not be completely imitative. Junior pupils will not take their drawings farther than this.

A good plan is to teach the principles by memory exercises from large and simple models, white, or light in colour, which can be placed against a plain, light background in a strong light coming from one direction. These memory exercises should enable a pupil to add light and shade to a drawing, and serve all necessary needs. The model will be arranged to illustrate a particular fact, and after consideration of it with the class it will be covered up and pupils will make a drawing of it from memory. From a few models—sphere, cube, cylinder, and hollow half-cylinder—the facts of light and shade, high light, half tone, shade, line of shade, reflected light, shadow, the relation of line of shade to shadow, and gradations can be deduced, as rules of perspective are deduced, from observation, and from the necessity which a pupil may feel for expressing something. The abuses of a rule or principle should be borne in mind so that neither the way the shading is done nor the principles of light and shade is reduced to a formula.

Shading should aim at fundamental things—roundness, recession, bulk, lightness, solidity, projection, weight, and what the pupil thinks or feels regarding the thing drawn. When trying to make a work of art it is not possible to keep one eye on beauty and the other on a rule. Someone has said that before they are any good, rules must be forgotten.

CHAPTER VII

Pattern Drawing and Design

The designing of surface patterns is an exercise which gives admirable training to the imagination and inventive faculty. It may easily drop into lazy conventions of no educational value whatever. Against that the teacher must be prepared. If a good method is used, and the pupil continually encouraged to self-expression and to make little inventions, prompted to use material suggested by the common beauties of the earth, and shown some of the finest patterns as a spur to endeavour, the bad habits of using the latest mannerisms, and of picking up tricks of pattern spinning, may be avoided.

Surface pattern designing may begin with the geometrical bases, or skeletons, of all-over patterns. These are stripes, checks—stripes crossed, square lattice, diamond lattice, diaper of octagons and squares, circles touching, circles interlaced, scale patterns, wave lines and ogee patterns. To these may be added for their suggestive names, though they will follow one of the skeleton bases just named, sprig patterns, knot and interlacing patterns, branching and scroll patterns. On these, or variations of them, all diapers and all-over floral patterns are based. Lessons in geometrical drawing will be necessary to teach the setting out of these bases. To draw them accurately and neatly is not easy. In the finished pattern the plan on which it is built should show; it is advisable to make a virtue of it and not to try to disguise it. The pattern should look orderly, and the evidence of its plan secures this.

Junior courses will deal with the simpler bases whose skeletons are squares and circles. These may be the foundation of patterns employing, for their enrichment, simple elements—geometrical forms, a device or monogram, natural things such as feathers, shells, fruits, a floral unit or sprig. The patterns so made should be used for exercises in colour harmonies.

The senior course will deal with the more complicated skeleton bases—diamond lattice, octagon and square, scale, wave lines and ogee patterns, interlacing patterns, branching and scroll patterns. Variety may be introduced into the patterns by making the detail of one set of shapes larger in scale than the detail of the remainder, filling some shapes with pattern and leaving others plain; the enriched shapes may be grouped in twos, threes, or fours. Coloured papers, if carefully chosen, may be used for this work, the patterns being painted in body colour where necessary.

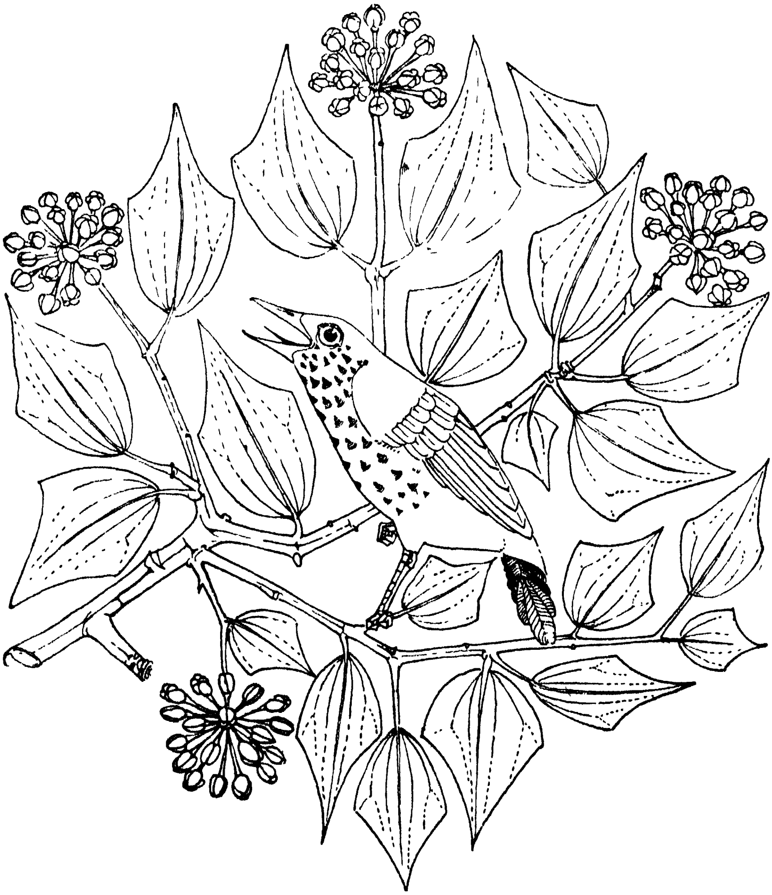


Fig. 1.—Design by Seniors

Another good way of teaching pattern design deals primarily with plants, foliage, and flowers: it is associated with drawing from plant forms. It presumes that pupils have, in their studies from nature, appreciated and memorized the character and growth of a plant. Fillings for the variously shaped spaces which are given by the skeleton plans of all-over patterns which have just been considered can be designed by this method. A drawing from a plant or flower is taken as a basis for a design, and the stems, leaves and flowers given in the drawing are moved to occupy a rectangle, or other shape, with as little violence to the growth of the plant as possible. At first the shape to be filled should be suggested by the general shape of the plant study so that the exercise is comparatively easy. It will probably be found desirable in order to make the design "read" to take out stems which cross, and to thin out the leaves. When the plant study is drawn from memory this simplification is already partly done, for the memory inclines to simplify, to give typical growths and shapes, concepts rather than the actual appearance of individual details. The illustrations to old Herbals, such as those which are reproduced in R. G. Hatton's book already mentioned, show the desired simplification nearly complete. The robes in Botticelli's *Birth of Venus* show a use for such patterns.

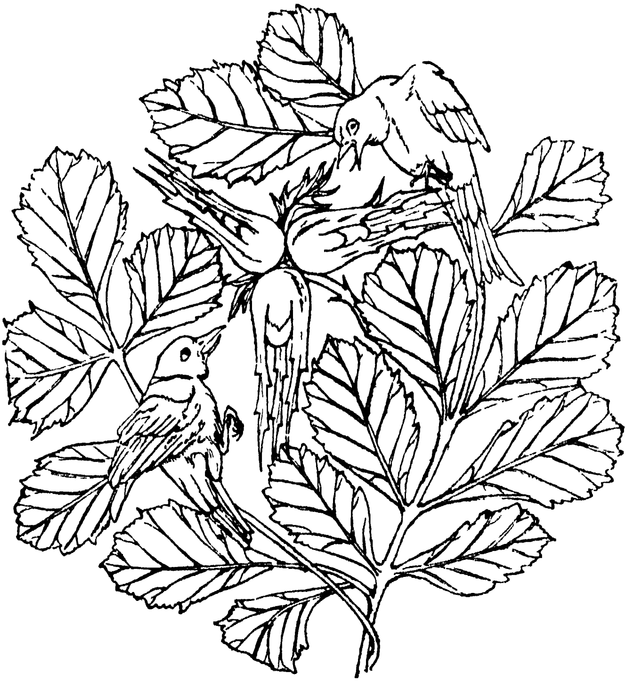


Fig. 2.—Design by Seniors

This way of designing will begin with a small spray which may be used in one of the diapers based on squares or circles. Such a spray could occupy the centre of a panel filled with a diaper. A set of four or five sprays designed to go together may be arranged as a centre, or placed one in each corner of the panel with one in the centre, or placed in alternate units of the diaper. Or, leaving diapers and all-over patterns, the space to be filled may be one which looks well by itself as a small panel. A diamond with its length upright is a good shape to begin with, following which a rectangle with its length vertical, an octagon, and a circle make a good sequence since the plant studies will more probably be high than wide. Where the nice arrangement of the plant within the space is at fault it is a good plan to make a tracing of the background in solid black, or a dark colour. This shows up a patchy arrangement. Attention has probably been given to outlines only. In pattern design these are of least importance. To make a good pattern the spaces should be seen, and a habit should be formed of looking for them. To focus attention on spaces it is a good plan to cut out of coloured paper a number of elements of various sizes (these may be flower and leaf shapes), and move them about the shape which it is desired to fill until a happy distribution is secured. A growth joining them together is then added.

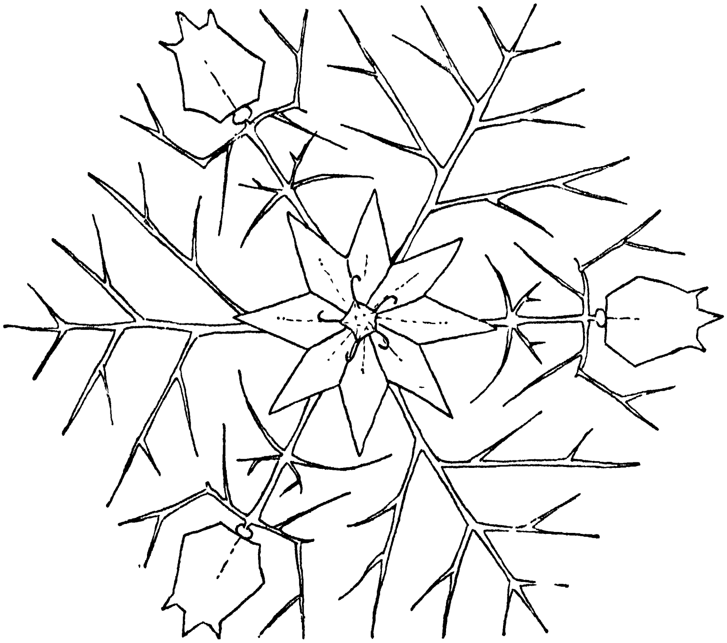


Fig. 3.—Design by Seniors

From a well-stored memory a pupil can make a design without reference to drawings. But the design should be imagined, and seen in the mind's eye, before the drawing is begun. This applies to its colour scheme also. The most should be made of a small number of units, and likewise the number of colours used should be restricted. But to make variety the colours can be used in various ways—solid, in lines, in dots, in small powderings, or in outlines. The colour should be clean, not muddy and vague. The work of Indian painters and embroiderers shows beautiful patterns of foliage and flowers done in the way suggested above. Photographs of some of it may be obtained from the Victoria and Albert Museum.

Another way of teaching pattern design is by the use of the lantern.

A beautiful design is thrown on to the screen, and after some minutes' close observation the pupils are asked to draw it from memory. Attention may be directed to the main lines of the design, the spacing of its parts, and to the character of its detail, but the class should have some minutes' uninterrupted study of the design. The point of this exercise lies in the fact that the pupils will not be able to remember all, and as a consequence will have to invent to complete the design. No two designs in the class will be the same, and those which are nearest to the original will be influenced by personal preferences.

Other exercises may be set by asking for variants on good patterns shown in photographs, prints, or casts. The planning of the original may be adopted in the variant and its foliated detail changed to that of a plant which the pupil knows well. Or the pupil may be asked to draw the example, changing some detail for a bird or shield, or an incomplete design may be given for completion. These exercises give opportunity for invention, with the criticism and suggestions which come from contact with a fine original. The exercise may be easy or difficult according to the problem set. A great deal depends on the quality of the originals which are put before the class. Unless patterns of the finest quality can be had, this method should not be used. The illustrations to A. H. Christie's book on pattern design show the right kinds. To have acquaintance with such patterns as those is to know some of the best. Taste and appreciation are improved by study of them.

The designing of surface patterns affords good training, but when these patterns have no practical end the exercises are robbed of considerable value. The importance of this point has already been stressed. Wherever possible the design should be linked with craft. Embroidery gives such an opportunity, and further suggestions on the teaching of design may profitably be coupled with that craft.

Design for Embroidery

The influence on design of the technique of embroidery is plainly seen in the samplers of a hundred or so years ago. Their charm is due largely to the fact that the ground on which they are worked suggested both the design and its treatment; the unit of the stitch is derived from the weave. Cross-stitch patterns, and others which take the weave of the ground as their starting-point, are usually good for this reason. Voluntary restriction to one type of stitch, or to one or two colours, often shows the value of limitations. The limitations and suggestions of the material must be turned to profit. Embroidery in coarse threads must not be used on fine material, nor delicate embroidery on a coarse ground. The material often suggests the kind of stitch and design most suitable. When pupils provide their own materials this question continually arises, for they may wish to use any of the multitude of modern fabrics. Relatively few of these fabrics make good grounds for embroidery. Our great-grandmothers were better off, for tradition had settled the best use and treatment of the few grounds which were then available. Peasant art, and traditional native work almost anywhere, show an appropriate combination of embroidery threads and grounds. A teacher should secure the loan of pieces of old or modern embroidery in which stitching and ground are in the happiest relation to illustrate this matter.

Designs for embroidery are often most successfully planned directly on the material itself. If a hat, or other garment, is to be embroidered the suitable places for decoration are best seen when the garment is on. The happiest hints arise in this way. Things which easily go wrong in a drawing are handled with more certainty if they are tried, in any tentative form, on the thing itself as it will be used. Such trials will show clearly the relation of lines and ornament to seams, hems, gathers or fastenings: the effect of rounded forms and folds on lines and other decoration: the size, scale, and colour of the embroidery in relation to the wearer. Embroidered lines and borders can be tentatively indicated with threads, cords, and bits of material pinned or laid on. If flowers and leaves are to be worked, actual ones can be used to indicate the size, shape, and position of the proposed decoration, and to give the general effect. The successful consideration of these things is more important than linear precision in detail. Not that detail is of no importance. If the simple question—is the work to be seen close or at a distance?—were always asked, a right treatment would more often be followed.

The method of planning a design direct on the material may be profitably used in designing the details. The translation into embroidery of the beauty of flowers requires sensitive feeling and nice invention; the needle is the tool for this, and not the pencil. To make a successful translation a pupil must know the flowers well and be able to appreciate their characteristic beauty. Studies of plants and flowers may be done in the classes for drawing. Some flowers lend themselves especially to the embroidery of dainty things which are to be seen close, and to the work of small size which children will do—pimpernel, woody nightshade, speedwell, veronica, the lesser saxifrages, hawthorn blossom, stony heartsease, coltsfoot, and wild strawberry are among them. A small vase or two filled with such flowers can be kept continually in the classroom if all help.

The bases of all-over patterns give many suggestions for the arrangement of designs for embroidery. Other arrangements are suggested by the construction and use of the thing to be embroidered, by the method of embroidery, or by the details which it is proposed to use in the design. Generally all three affect the design and the happiest results are obtained when each contributes its share.

Borders are among the most useful elements of embroidery decoration. Some embroidery stitches make good borders in themselves. Borders may be arranged in various ways. For instance, a square cloth may have a border round its sides enhancing a plain centre, or the cloth may have a border of octagonal shape with separate units in the corners of the cloth, or a circular border may be used with sprays running from it into the corners, or again the border may follow the shape of the cloth and be repeated one border within another. Floral details may be added to borders of lines in sprigs or sprays, or in little panels of which some may be plain and others contain an ornament, or a wavy stem may run along the border with leaves or flowers on it. These are some of the usual types of border.

At its best, pattern should have a meaning, and this meaning may be something of a personal revelation, be a happy invention, intended to remind us of a delightful experience, idea, or thing—dew on cobwebs, the flowers appear on the earth, " the lark now leaves— ", the merry month of May. A line of poetry may suggest the pattern—" The feathers of the willow are half of them grown yellow ". It is fatally easy to formalize the teaching of design and take all expression of joy and pleasure out of it.

CHAPTER VIII

Appreciation of the Beautiful

The teaching of æsthetic appreciation is the most difficult thing an art teacher attempts, for it is probably true that art, and a love of beauty, cannot be taught. (It is realized that there is a difference here. An opportunity may arise for making a distinction.) Direct teaching is no doubt a mistake. Because of this, the importance of environment, and the use of none but beautiful things for the purpose of lessons, have been stressed throughout these notes. If the love of beauty, which nearly all children have, is given opportunity for exercise, and encouraged, it will grow. Beautiful environment, and familiarity with lovely things, stimulate it. You must have the chaste and beautiful to influence a cultured people.

But growth in æsthetic appreciations must begin early and be developed from a child's natural pleasure in pretty things. It is through the eye, and not the brain, that feeling for beauty begins. Such growth as may be made after children are grown up is weak, uncertain, and biased by inimical and settled habits of mind. Æsthetic development is killed in those children whose minds are wholly absorbed, during several formative years, in studies from which love of art is excluded. For artistic interests cannot be put on one side, left for years, and taken up again. Their growth, like any other natural growth, must be continuous.

A teacher's enjoyment of lovely things is contagious and helpful, though undue enthusiasm may have the opposite effect. In the nature of things a teacher may easily dominate and constrain, but it is possible to show ardent preferences without coercion. From the exercise of personal choice a pupil's taste must grow, and opportunities for the exercise of it must be offered continually. To put pupils into the position of having to choose between one and another lovely thing is part of a teacher's work, as the most important part is to teach them to see. Ways in which these things may be done are given in the following suggestions for equipment. The material must range from pretty stones a child will play with, to reproductions of masterpieces, and these must be shown in an attractive way where they may be seen, and enjoyed, without restraint. Examples may be selected to show things superficially alike but fundamentally different; things which show beauty in unexpected places may be placed by the side of things generally admired; contrasts in form, colour, and design; one thing only, and that shown with special care; things forming a sequence which prompt a growth in appreciation; different treatment of the same subjects by European and Eastern artists; town and country amenities. From things such as these, and many others which loans and a good collection of material will suggest, a teacher may prompt pupils to make a choice, and to enjoy. For the matter should be founded in enjoyment. Too often an adult taste, imposing itself on a child's, rules out delight born of enjoyment of beauty, and substitutes an intellectual interest.

After a year or so the pupils will come to look for changes in the things exhibited, and expect to be interested and enjoy them. When a habit has been formed of looking for beauty where pleasure is, an important piece of work will have been done. The interest of juniors will be met with like frank and ingenuous pleasure and interest. Questions which senior pupils may ask will receive a sympathetic reply, possibly a suggestion which may increase their enjoyment, at most a further question. "If you get simple beauty and nought else you get about the best thing God invents."

Introduction to the Appreciation of Pictures

The spirit in which this may be begun is suggested in the preceding paragraphs. For the teaching of colour it was assumed that opportunity for the enjoyment of colour should be provided first of all, as books are provided for English. The interest aroused by that enjoyment suggested lines of study, and so with pictures. But pictures are difficult to provide. If there is a good art gallery within reach that will give excellent material, but there are limits to its collections, and unless the National Gallery can be visited but few acknowledged masterpieces will be known at first hand. Reproductions must serve. Where good reproductions in colour are obtainable these should be bought, for the colour of a picture is often more important than its form. A brief list of reproductions in colour is given on p. 226. Continual study of pictures in monochrome is misleading. The great reduction from the size of their originals is another drawback to most reproductions. Some effects, as of light and space, cannot be conveyed in copies reduced to small size. Reproductions should send pupils repeatedly to see originals new and old. And, because reproductions often convey but little of their originals, pupils should be led to see pictures everywhere, and enjoy, as personal discoveries, the elements from which pictures are made. To this extent all may be artists, able to enjoy what is beautiful if not to give expression to it. If pupils are taught to see they may share an artist's vision. It is an important part of an art teacher's work to teach them to see.

The first question is not so much how to look at pictures, or what pictures to select, as to increase the delight in pictures which began with picture books and should, without break, end with masterpieces; therefore questions of the history and technique of painting will be dealt with in a senior course and probably at the end. It will be enough if juniors have formed a habit of enjoyment of pictures of acknowledged merit. Biographical details may occasionally help, but the appeal of pictures shown to juniors should be irrespective of date, school, or technique. These things may help when enjoyment prompts a desire to know more.

Pictures for juniors will be chosen for their human interest and associations first; pictures of other children may serve. But it is unwise to draw a line, for a work which relies for its appeal on beauty and pictorial quality —as when light is the subject of a picture—may evoke the joyous response. But a teacher will have to make a selection, and—taking hints from pupils, and having in mind such suggestions as are made earlier—this may be done in ways such as the following, by showing: two pictures together which prompt questions and lead to comparisons; one picture which gives an ordinary rendering and another picture of the same thing which shows a novel treatment; how well the story is told. Or, here are landscapes, some are of country you know; are these different ones our country too? What is the artist trying to show? Or pictures may illustrate vigorous contrasts with delicate treatments of the same subject, portraits of boys and girls, portraits which are similar in arrangement but different in treatment, one may be Italian, another English; how can we tell which is which? does this portrait tell us more of its subject than that? Typical Italian, English, French, or Flemish pictures may be contrasted, or, with older pupils, Florentine and Venetian. A picture and a photograph of the same or a similar subject prompts the questions: What does the photograph give? why does the artist select?

From a good collection of slides and prints many other pictures may be selected to prompt questions on subject and treatment of realistic and imaginative works. The juxtaposition of examples should heighten enjoyment of them and have sufficient reason in it to prompt comments and questions. Pupils should be given opportunity but not worried to talk about them. It will not serve if the teacher offers the first and only remarks. Some pictures will raise no response and must be passed, they should be shown again later. A fine piece of music is not always enjoyed when heard for the first time. None of the examples should be left on the screen long.

As interest develops in older pupils, the following matters can be tentatively introduced. It should not be overlooked that these things may hinder growth in appreciation instead of helping it. We may see this happening in any of the larger galleries, where the purpose of many visitors seems to be confined to verifying Baedeker. The order of the matters which follow is suggested by the development of a child's interest: biographical details, choice of subject, methods—drawing, colour, light and shade, water colour, oil, etching, engraving, lithography—what can be expressed best by each, outline in pictures of the history of painting, schools of painting, the pattern of a picture, centre of interest, style. Laws of composition and detailed analysis of the design of pictures are probably too technical to be dealt with.

One picture is reproduced by way of illustration to these notes. Many comments on the subject of *Christ in the Carpenter's Shop*, by Millais, will be prompted by its dramatic presentation. The tender solicitude of all for Christ will appeal to children. The story is easy to read. The bench, tools, and wood of the workshop will be noticed, but perhaps children will not see the allusions indicated by the flock of sheep and the dove on the ladder. The lovely colour will be enjoyed. Older children will probably notice how well the picture is painted. Some day they may see the original and marvel at the consummate painting of the head of the Virgin. The "pattern" or arrangement of a picture usually tells a great deal. In this picture older pupils will probably notice that the figures are placed almost symmetrically round Christ, and by action and linear arrangement lead the eye to him. To show how necessary each part is to the harmony of a well-composed picture some piece of it should be covered up. The loss should be obvious. The distribution of the reds in the picture suggests that this is tried here. Reproductions of the lovely drawings which were made as studies for this picture might be shown to senior pupils, who would be interested to see how a picture is built up.

BIBLIOGRAPHY

GENERAL

Revolutions of Civilization. Petrie.
Form and Civilization. Lethaby.
Ancient Times: A History of the Early World. Breasted.
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MUSIC

BY

ARTHUR LYON, M.A.

MUSIC

CHAPTER I

Introduction

The music teacher in schools has perhaps a greater responsibility, and at the same time greater opportunities, than the teacher of any other subject. For while music is undoubtedly the most important of all cultural subjects, inasmuch as it enters so largely into the life of the whole people, it is still the Cinderella among school subjects. In spite of a few bright spots in one or two large towns, and very occasionally in small towns and rural districts, its teaching on the whole is aimless, planless, and purely haphazard. In not a few secondary schools it is fighting for its bare existence.

But if schools are to reflect the national life and outlook, this state of things must radically change. The prime necessities for any improvement are: a greater precision of aims and outlook in school organization of the subject; wider activity in secondary schools, training colleges, and universities in regard to the musical training of future teachers; and a deeper musical interest on the part of educational authorities, their directors and inspectors.

The immediate future depends on individual enthusiasts. The new central schools may win the battle of culture by a flank attack. The Board of Education's *Suggestions to Teachers* in the province of music form a basis of instruction admirable in every way, particularly for the junior school. The remarks on the injury to voices caused by class teachers and by singing during the voice-breaking period are, however, debatable. Opinion among many choirmasters and other experts is that the injury to the voice through use during this period is much exaggerated.

The Hadow report refers to senior and central schools, and gives some valuable suggestions in the school organization of the subject. At the same time there is a certain vagueness of thought in the use of the words " taste " and " proficiency ". Ten minutes a day of choral singing by the whole school is, however, a recommendation of the highest value. In addition, two lessons a week should provide the necessary opportunities for the full development of the musical faculties. But one lesson a week for appreciation seems excessive, and even unsound psychologically, for all but the oldest scholars. In the first and second years (11–13) of a senior school, the knowledge or conception of music in general is insufficient to make the listening to abstract music for more than a few minutes at a time valuable, or to render possible the arousing of fresh percepts to any extent. The " known " must be fairly extensive before we can proceed by anything more than a few steps towards the " unknown ".

Aims and Organization

In musical instruction the end in view should be analogous to that, say, in the teaching of English. It is expected that pupils by the age of 15 to 16 should be able to read ordinary English, write it grammatically, and have the foundation of an acquaintance with the masterpieces of English literature. So one would aim at pupils at the same age being able to read ordinary music at sight, to write down a melody when heard, and to have some knowledge of the masterpieces of music.

The question of taste is beset with dangers. Patience and tolerance are necessary. Weber, a great musician, after hearing Beethoven's seventh symphony for the first time, said that the composer was fit for a madhouse. To Tschaikowsky's violin concerto a most opprobrious epithet was applied by a prominent critic after the first performance. Both are now among the most cherished possessions of music-lovers. The Joachim classical school of Berlin would not allow that there was any merit at all in Wagner's music. And so one could go on. Let the watchword be, " No dogmatizing ".

For the organization of musical instruction big schools will have a specialist who should be a regular member of the staff. Gifted men and women teachers do not, however, care to devote all their time to music, if only because it tends to bar them from promotion to a headship. The ideal arrangement is to have one enthusiast on the staff responsible for the school music generally, who would enlist other members willing to co-operate.

A piano, the best obtainable, is a practical necessity for music lessons, and can be used in a variety of ways: to play a new song or tune, to give out a phrase for musical dictation, to emphasize rhythm, to accompany a class singing, &c. If of good tone, some hints on expression can be conveyed by it, and if a gifted performer is available it will play its part in appreciation lessons.

CHAPTER II

Curriculum

Junior School

In the junior school, that is to about 11 years of age, scholars should have covered some such course as the following, to serve as a foundation for the senior school:—

Ear-training and Sight-reading.—Exercises in the major scale intervals, and the *doh*, *me*, *soh* chord; position on the staff of *doh* in the keys of C, G, F; scales in these keys and translation from one notation to the other of separate notes; sol-faing of tunes learnt; names of notes in the staff, E, G, B, D, F, &c.

Time and Rhythm.—Two- and three-pulse rhythms (common and triple time); the bar; time values in tonic sol-fa and staff notations (quaver, crotchet, semibreve); dotted note.

Singing Technique.—Practice of the six long vowels—ah, oh, oo, ay, ee, aw; instruction in and practice of breathing exercises.

Melody.—Broad characterization of melodies and melodic phrases, with or without words, e.g. cheerful, sad, dreamy, strong, low-spirited, fighting, &c.

At least twenty good folk and traditional songs should have been learnt, which will provide material to work on in the senior school. These should be chosen mainly for their rhythmical qualities.

There is an excellent graded list of songs at the end of Dr. Carroll's *Handbook of Music*, published by the Manchester Education Committee. This does not by any means exhaust the treasures available for teachers. Quite a number of beautiful and suitable songs are omitted, no doubt through limitations of space. The names of notable and suitable songs that are not in this list will be mentioned at the end of the notes in each year of the suggested curriculum.

The following collections of songs can be recommended:

Curwen: *English Folk Songs for Schools*, Cecil Sharp; *Approved Songs* (in three sections); *Songs of the British Isles; Shanty Book; Graded Song Books.*

Hawkes & Son: *Twice 44 Sociable Songs; Twice 55 Community Songs.*

Novello: Various collections of traditional and modern songs.

Boosey & Co.: *National Song Book; Community Song Book.*

Bayley & Ferguson: *Folk, National, and Art Songs.*

For the tonic sol-fa notation and instruction therein, Curwen's *Standard Course in Tonic Sol-fa* is entirely reliable. There are other good books in the catalogues of the various publishers.

Senior School, First Year (Age 11+)

Ear-training and Sight-reading.—Major and minor (melodic scales); diatonic intervals; tonic and staff modulators; sol-faing tunes without modulation already learnt; translation from one notation to the other; tonic, dominant, and subdominant chords; reading phrases at sight; naming and writing down intervals, and later, short phrases played or sung by the teacher; key signatures of C, G, D, F, B♭.

Time and Rhythm.—Time values of notes in staff notation; pulses, beats, and accents; barring of phrases.

Technique of Singing.—Voice training and careful articulation of vowels and consonants; breathing exercises.

Melody and Composition.—Unison songs and one or two easy two-part songs; elementary analysis of the form of one or two simple melodies.

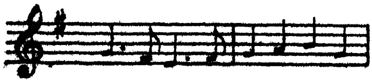
As wide a selection as possible should be made of folk and traditional songs. Some of the fine modern songs should be included as well as those of classical writers, such as *Creation's Hymn* (Beethoven). Especially should some of the very beautiful songs of Schubert from the cycles *Die schöne Müllerin* and the *Winterreise* be learnt. Some of these will be added during succeeding years. There is also a splendid rollicking series of shanties published by Curwen, which are naturally very rhythmical as well as tuneful, and make a great appeal to the young. If the reading powers of the class are developing, one or more two-part songs may well be introduced, as well as the simpler rounds. The class might be divided into two sections, and alternate in singing the first and second parts. Also half a dozen might be chosen to sing the selected piece before the rest. Rounds will need three or four divisions.

Characteristics of the minor scale. One or two songs should be learnt in a minor key, e.g. *To the Maypole*, *God Rest you merry, Gentlemen*, *David of the White Rock*, a beautiful Welsh minor tune; but a good plan is to turn occasional phrases from a major song that has been learnt into the minor, e.g. the descending scale in *Caller Herrin'*.

Two-pulse and three-pulse rhythms along with the time-values of the staff and tonic notations already worked at in the junior school should now be developed and consolidated and brought within the comprehension of the class. See the chapter on TIME AND RHYTHM.

The breathing exercises should be continued, and attention given to articulation of vowels and consonants as directed in the chapter on THE TECHNIQUE OF SINGING.

The class should be practised as much as possible in the staff notation with the sol-fa names, and every school should have a staff modulator as well as a tonic sol-fa one. The latter will continue to be useful in lessons on modulation. For the staff modulator it is advisable to have a cardboard crotchet, black or white (reversible for convenience), fastened at the end of the pointer.

Rapidity in writing on a blackboard provided with the staff lines (another necessity) is helped by writing a thick stroke for a black note  and two half circles ○ for a white note.

The three chords should be made thoroughly familiar to the class, treated as harmony, and played successively in different order—and as arpeggios, both major and minor. The class could be questioned as to the order in which the three chords are played.

In addition to Dr. Carroll's list the following songs can be recommended as specially suitable for this year:—*David of the White Rock*, Welsh; *My Love's an Arbutus*, Irish; Schubert songs, *Wandering Miller*, *Whither*, *Rose among the Heather* (N.); *O Sunny Beam*, Schumann (N.).[1]

Two-part songs:—*I would that My Love*, *Greeting*, Mendelssohn (N.);[1] *Twinkle*, *Twinkle*, Rathbone, in canon form (N.).[1]

During the school life some 10 or 12 of the great hymn tunes should be known and sung occasionally at the morning service by the combined school. Among these one would particularize: *Ein feste Burg*, *Wachet auf* (Sleepers wake) in the early free rhythm; *Passion Chorale*, *Lasst uns erfreuen*, *Braint* (Welsh), *Psalm CXXX* (Scotch, derived from German), *St. Anne*, *Old XLIVth Psalm*, *Jerusalem*, *Sine Nomine*, *Gonfalon Royal.* The last three are modern, but they are worthy to be ranked with the classical tunes mentioned before. They are all to be found in the *Hymns of the Kingdom* (O.).[1]

Senior School, Second Year (Age 12 +)

Continuation and extension of the work done in the first year.

Ear-training and Sight-reading.—Diatonic scales including the harmonic minor; modulation to nearest keys (*fa* and *te*); reading at sight new tunes and phrases; musical dictation; keys in progression in the staff notation.

Time and Rhythm.—Simple and compound rhythms; elementary syncopation.

Technique of Singing.—Continuation of articulation practice and breathing exercises.

Melody and Composition.—Construction of tunes, opening statement, answer, completion; unison and two-part songs; canon form; one or two three-part songs.

Listening and Appreciation.—Single short movements from the classical dance suites or sonatas, alternating with an occasional vocal item.

Some outstanding unison songs will be sung during this year, but two-part songs will form an important part of the work, with one or two easy examples in three parts if the class prove capable. The song *Twinkle, Twinkle*, by Rathbone (N.), in canon form may be introduced here, if not already learnt, and with it Tallis's canon, usually sung as a tune in four parts to the hymn *Glory to Thee*, *my God*, *this Night.* It may be taken as a two-part song, the second division singing the tenor part in the same octave as the first part. Also Holst's *Song of the Shipbuilders* (N.), in a less familiar style.

The rounds met with in the collections used will prove a diversion during the progress of the work. Modulation from one key to another, which is treated in the chapter on SIGHT-READING, will be begun.

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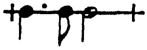
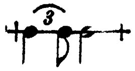
[1] See key to publishers at end of chapter.

Sight-reading will be developed with wider leaps, and the staff modulator should be in constant use.

Care should be taken to get a clear understanding of the dotted note, and particularly the distinction between  and 

With the reading at sight musical dictation will continue and develop. If more than two or three notes are to be written down, the class should in the early stages sing by imitation before writing down the phrase.

With this may be combined the analysis of one or two folk songs: opening statement, answer, completion. See chapter on MELODY AND COMPOSITION.

Of unison songs Purcell's *Nymphs and Shepherds* (N.) should be included in this year. Apart from its excellence as a song it is a splendid exercise in flexibility. Not mentioned in Dr. Carroll's list are:—*It comes from the misty ages* (Elgar) and Schubert's *Serenade* (N.). Three-part songs of moderate difficulty and very attractive are:—German's *Orpheus with his lute* and Walford Davies's *Cradle Song* (N.). Of the two-part songs in Dr. Carroll's list one might single out Ireland's *There is a garden in her face* (N.) and Stanford's *The Lark's Grave* (C.).

Senior School, Third Year (Age 13+)

Development and extension of work done previously.

Ear-training and Sight-reading.—Diatonic scales; modulation; diatonic and chromatic intervals; the Dorian mode; naming of intervals, third, fifth, &c.; perfect, augmented, and diminished intervals; the great stave and clefs; translation—sung and written—from one notation to the other; musical dictation and sight-reading extended.

Time and Rhythm.—Regular and broken rhythms; syncopation; poetical rhythms compared.

Technique of Singing.—Articulation of vowels and consonants continued; clear enunciation of words.

Melody and Composition.—Form in melody; construction of melodies.

Listening and Appreciation.—Sonata form (3 or 4 movements, and construction of first and last); some acquaintance with leading composers—Bach and Handel to Schubert; movements from their works played by pupils or friends or on gramophone; examples of chamber music.

The principal work in this year will be to strengthen all that has been done in the previous years, especially in sight-reading and musical dictation.

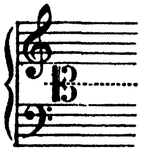
Modulation into neighbouring keys and the progression through the sharp and flat keys will need constant practice. This is treated in the chapter on SIGHT-READING.

Musical dictation should be freely used this year. There is a report of a class of boys and girls, 13 to 14 years of age, some of whom could write down phrases in two parts after hearing them played two or three times. If practice is consistent throughout the course, the capacity of juveniles in this direction is much greater than is commonly supposed. There may be a young Mozart in the class, and it is well to offer opportunities for exceptional ability to reveal itself. A budding genius might write tunes in unison or in parts for the class to sing, and even surround the school with a halo of glory.

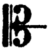
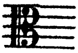
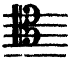
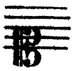
A teacher will practise locating the weak members of a class in singing as well as in answering. Inability to sing phrases in imitation is no proof that musical capacity is entirely lacking. It is said that the great violinist Joachim was unable to sing in tune, and yet his intonation on his instrument was perfect, and he excelled as a composer as well as a violin virtuoso.

In mixed or in boys' schools, some of the boys may have developed their lower notes enough to sing tenor or bass parts. If so, one or two four-part songs for mixed voices might be attempted, and some of the songs in *Cantemus* (C.) arranged for soprano, alto, and bass. This would be preferable to singing a treble part an octave lower. Such practice is not objectionable in unison songs, but it is unpleasant in part-singing.

In the treatment of the staff notation it should be pointed out that our two ordinary staves in the treble and bass clefs are parts of an imaginary great stave of 11 lines, approximating roughly to the vocal range



from the soprano to the bass, the centre line C being omitted to prevent confusion.

Vocal music is now almost entirely restricted to the soprano or G and the bass or F clefs, the signs being derived from those letters. The middle voices, alto and tenor, used to sing from clefs which had a range round the middle C line corresponding to their voice, the C line being shown by the clef sign . Thus alto clef , tenor clef . These two clefs are still used for the instruments that correspond to these voices; that is, the viola and the alto trombone use the alto clef, while the tenor trombone, the cello, and the bassoon use the tenor clef alternating with the bass or soprano clef if the range requires it. It is not long since for sopranos a special clef was used, the C sign being on the bottom line of the stave . This is not yet entirely discarded on the Continent.

Syncopation as treated in the chapter on Time and Rhythm should be studied.

Representation of the chief poetical rhythms may be shown in musical notation.

In connexion with the scales, a word may be said as to the mediæval practice of using scales and founding tunes thereon, with any note of our scale, as well as *doh* and *lah*, as the basis. Of these modes so-called, several fine examples of the Dorian, based on *ray*, have come down to us. The splendid Welsh tune Braint, and the fine German tune named Psalm CXXX, from the Scotch Psalter (*Hymns of the Kingdom*) are examples. Beethoven has a movement in his 15th Quartet in the Lydian mode which is based on *fah*. Examples of these modes, apart from the Dorian, are rare.

Some talk there should be this year on the great composers, especially from Purcell to Schubert. A song sung by the class from each of these composers will make them live more in the juvenile minds. Here is a suggested list: *Nymphs and Shepherds* (Purcell); *My heart ever faithful* (Bach); *Let the bright seraphim* (Handel); tune *Austria* (Haydn, from Quartet) or *In Native Worth* from *Creation*; *Say ye who borrow* (*Voi che sapete*) or *Ave Verum* (Mozart); *Creation's Hymn* (Beethoven); *Serenade* (Schubert).

Specially recommended but not in Dr. Carroll's list are: unison songs:—*The Walnut Tree* by Schumann (N.); Schubert's *To Music* (N.); two-part songs:—*It was a lover and his lass* by German (N.); Coleridge-Taylor's *Drake's Drum* (C.); three-part songs:—Elgar's *Snow* (N.); Walford Davies's *The Shepherd, The Lamb* (N.); Elgar's *As torrents in summer* (N.). If there are breaking voices in this year and some have settled enough to take a bass part, *Cantemus*, already referred to, will provide excellent material.

Senior School, Fourth Year and after (Age 14+)

This all-important year should be occupied in completing, strengthening, and extending the work of the previous years. In particular, tunes modulating into other keys will be practised in the sight-reading exercises, and musical dictation in one and two parts. If the class is sufficiently practised, a short phrase in two parts might be played two or three times and the class asked to write it.

Rhythm and syncopation study should advance, and the five and seven rhythms as found in some modern composers be listened to.

But if the previous work has been done thoroughly, the teacher might introduce the elements of harmony, remembering that practice must precede as well as accompany theory. No rules must be given that have not been previously explored as far as possible in the hymns or part-songs learnt.

Before the end of the year the majority of the class should be able to write a bass to a given melody, and write a parallel part or descant above a known or dictated air. Many examples of such treatment are now published by music publishing firms, and some are admirably done.

In mixed classes the boys' voices will have mostly broken and some will be approaching settlement. They may sing any unison songs an octave lower, or sing the tenor and bass parts in four-part songs. They should not in any case force the tone or shout. The tenor part is more difficult to find than the bass, as most boys think it manly to sing bass The publication *Cantemus* has already been mentioned.

Listening and appreciation will now be carried further and include the masterpieces of music in every form, except perhaps in opera. The structure of the first movement in a symphony or sonata, based on two contrasted themes, may be explained. Mozart's G minor symphony, Haydn's London Symphony, and Beethoven's great C minor are good examples and likely to be interesting to the class. The last movement, either a rondo, as in Beethoven's Waldstein Sonata, or built on similar lines to the first movement, can be explored in conjunction with the first. The slow movement and the dance movement, minuet or scherzo, are other sides or phases of life. The great composers, however, put their strength into the first movement. Gramophone records of suites, overtures, &c., can now be obtained in profusion, as well as some splendid examples of chamber music, such as the great B flat trio of Schubert, and Beethoven's Op. 97, played by Cortot, Thibaut, and Casals.

In the case of vocal records those should be chosen where the voice is steady and the portamento rarely used. Many singers, even prominent ones, have bad faults. The commonest is breaking up the rhythm in order to emphasize emotional effects, or for a display of the voice; there are others, such as a persistent vibrato, often causing false intonation; excessive use of the portamento; stressing every slight emotion, and general exaggeration in order to produce an effect. These faults need pointing out so that the class individually may guard against them.

By musical dictation is meant the writing down by the class of intervals and phrases sung or played by the teacher.

Suggested songs in addition to those in Dr. Carroll's list:

Unison.—*When the heart is young*, D. Buck (C.); *Let Bucks a-hunting go*, C. Sharp's Folk Song Collection (C.); *This Endriss night*, Grieg, arr. from Scandinavian song (A.); *Worship*, G. Shaw (N.); *Come where golden-hearted Spring*, Handel, arr. Whitaker (O.); *Der Jäger* from *Die schöne Müllerin*, Schubert (O., Schubert Songs); *Serenade*, Schubert (O., Schubert Songs); *Great is Jehovah* (*Die Allmacht*), Schubert (B.); *The Lotus Flower*, Schumann (N.); *My heart ever faithful*, Bach (N.).

Two-part.—*Drake's Drum*, Coleridge-Taylor (C.); *Piper's Song*, Rutland Boughton (N.); *Prayer* from *Hänsel and Gretel*, Humperdinck.

Three-part.—*Lift thine eyes*, Mendelssohn (N.); *O, Can ye sew cushions*, Bantock (N.); *Snow in Spring*, Reinecke (N.); *Sumer is icumen in*, traditional (C.).

If possible to arrange, this class, or a selection, might join with the third year in some of the part-songs, or better still in a small work like *The Pied Piper of Hamelin* by Rathbone (N.). In a secondary school some of the girls from the higher forms might join in. If the boys are developing powers of taking tenor and bass parts, an alliance might similarly be made with the higher forms where the lower register would be generally more settled.

Mendelssohn's four-part songs are all good. The following are also excellent examples:

Miller's Wooing, E. Faning (N.); *The Vikings*, E. Faning (N.); *True Love's a Gift*, C. Wood (Y.); *These sweeter far than lilies are*, Walford Davies (C.); *Sweet Day*, Vaughan Williams (W.); *Better Music ne'er was known*, Parry (C.); and multitudes of others.

One or two of the choruses from the *Messiah* or another Handelian work might be attempted. A short attractive work such as *Hiawatha's Wedding Feast* (Coleridge-Taylor) would afford most interest. If a few mature tenors and basses from among the male members of the staff or parents and friends could be enlisted, a full performance could be achieved which would give pleasure to everybody, especially if an orchestra could be added. The knowledge will eventually spread of what power and brilliance there is in a chorus of juveniles in their teens, and what choral achievement they are capable of. At present it seems to be grasped only by a few. (See chapter TECHNIQUE OF SINGING: school choral possibilities.)

The course here set out goes farther than that hitherto covered in the large majority of senior elementary or central schools. Provided, however, that the foundations are thoroughly laid in the junior school, and that there is skilled teaching allied to enthusiasm in the senior school, such a course can certainly be covered by the age of 15 or 16. There will always be a few exceptions who will fail to keep up their interest in the work, as there are in other subjects, such as mathematics and languages. Such cases are estimated to be about 2 or 3 per cent of the whole. Very occasionally an individual actually tone deaf will be met with, and such a person might be allowed to attend another class unless there was a wish to remain in the music class.

KEY TO PUBLISHERS —(A.) Augener, (B.) Boosey, (Ba.) Bayley & Ferguson, (Br.) Breitkopf & Härtel, (C.) Curwen, (H.) Hawkes & Son, (N.) Novello, (O.) Oxford Press, (W.) J. Williams, (Y.) Year Book Press.

CHAPTER III

Ear-training and Sight-reading

This must be the foundation of all music teaching, music development, and music appreciation. It will start with the singing of simple rhythmical songs, and should lead on to the acquisition of the power to read any ordinary melody at sight, and eventually to the principles of harmony.

No one can be looked on as musically educated unless he or she is able to write down in one of the notations a melody when heard, or, on the other hand, to form a mental conception of a tune from the printed copy and reproduce it vocally.

This must always be borne in mind from the earliest stages of instruction, and the foundations laid must throughout be strengthened by constant tests and repetitions. All instruction should be based on songs or tunes learnt, and no information should be pumped into juveniles that has not gradually developed from the music they themselves have practised. If they learn a song, and in that there occurs a scale or a part of one, or the notes of the tonic chord, *d*, *m*, *s*, d^1, such things are living possessions with them and can well be made the basis of further development and understanding.

Junior School

Based on these principles the work in the junior school will progress from the tonic chord, examples of which are found in bugle calls, songs such as *Oh dear, what can the matter be*, the buffo song from *Figaro* through the pentatonic scale *d*, *r*, *m*, *s*, *l*, d^1, the oldest scale, and the basis of *The Flowers of the Forest* and other early songs. The opening of the overture to the *Mikado*, from Japanese sources, is also written to this scale. Then will come the complete major scale, and during the last year of the junior school the melodic minor scale. Examples of the major scale are found in *The Two Magicians* (descending) in C. Sharp's Collection of Folk Songs and *We be three poor Mariners* (ascending). For the minor key there are the Welsh tune *Aberystwyth*, *To the Maypole*, *God rest you merry, Gentlemen*, from which the minor scale can be pieced together.

Practice in singing and naming the intervals of these scales in connexion with the songs learnt will be constantly given. The practising of scales without any connexion with melody, unless for some other purpose such as vowel pronunciation, should not be resorted to. It is purely abstract and as such is alien to the child mind. It would be akin to the counting of 1 to 10 and back again in an arithmetic lesson.

In the last year (age 10–11) of the junior school a beginning should also be made of musical dictation, that is, of writing down simple intervals sung or played. Until the class can make some attempt at this, no progress should be assumed. Juveniles are most impressionable, and in viva voce questions and answers there is always a large amount of suggestion from neighbours, conscious and unconscious. But proficiency in accurate detection of intervals, singly and in succession, is only likely to become a possession of the community in the higher classes. One can only aim at crossing the threshold in the junior school, that is approximately by the age of 11. If an inspired teacher can get his pupils farther, it will be counted to him for righteousness and he will have his reward. *He*, of course, may be *she*.

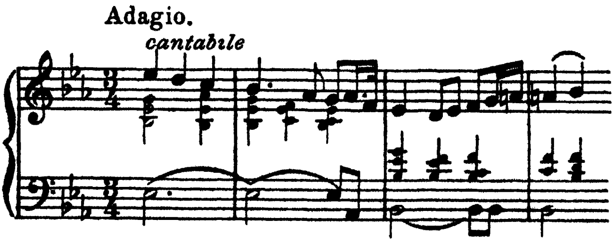
Senior School

In the senior school, from the age of 11 or so onwards, the diatonic scales will be completed by adding the harmonic minor, *me*, *fah*, *se*, *lah*, and downwards *lah*, *se*, *fah*, *me*, &c. This gives an interval of a tone and a half, and instances of this scale are probably not to be met with in folk songs, as it is a later harmonic development. It would usually denote a passionate utterance. Examples are to be found in Schubert's emotional *Young Nun*, Mendelssohn's *Venetian Boat Song*, and much more frequently in instrumental compositions.

The scales should be sung in both common and triple time, and melodic suggestions associated with such singing.

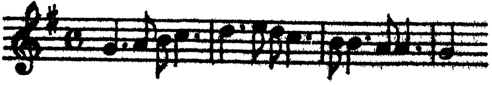
Instruction in all these matters should be given very sparingly, and only when associated with some singing practice in which the whole class participates. Nothing is so pleasant to a teacher as to be pouring information from his abundant store into the comparatively empty heads of a young class, which sits in silence and apparently full of interest and attention before him; and nothing is so boring and tiresome to the child. Their minds will gradually fill only by participation in what is going on, and in a music lesson this participation usually means singing.

In the upper classes the horizon will gradually extend. Wider intervals will be practised, and passages by leaps as well as by steps sung, and their characteristics investigated. Songs more elaborate in tune as well as time can be attempted. Elaboration, however, does not necessarily mean an increase of beauty. The scale itself may form a really beautiful tune by the varying of the rhythm. *Caller Herrin'* is in part an example. Beethoven, in the lovely melody of the slow movement of his fourth symphony, simply uses the descending scale with a slight break before the bottom note, and a return, also stepwise, to the dominant.



If the class sol-faed the passage while the chords were softly played, there would be a perception of what a great master can do with very simple material.

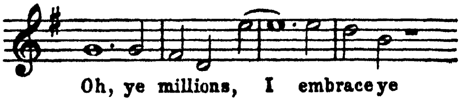
Nothing is more uninspiring than five-finger exercises, yet by the addition of one note, *lah*, to the usual five notes, *d*, *r*, *m*, *f*, *s*, and with a variation of the rhythm, we get one of the most stirring of Hungarian tunes, *Far and high the cranes do fly*. Liszt uses this as the



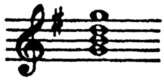
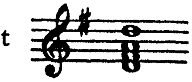
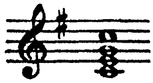
basis of his 1st Hungarian Rhapsody: of such tremendous importance is time, rhythm, accent.

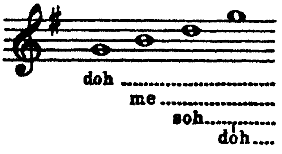
An example of some well-known tune might be written on the board without regard to the length of notes or accents. The class can read it off with equal notes and will probably not recognize it. It would then be sung with its appropriate rhythm.

The foregoing examples proceed by steps. Leaps, that is passing over one or more intermediate notes of the scale, can now be practised, of greater or less extent. They usually impart a more stirring character to a piece. Thus, Beethoven in the 9th Symphony, when he wants to express the tremendous joy welling up within him from the feeling of love to all mankind, makes the male voices leap a ninth, or one note above the octave:



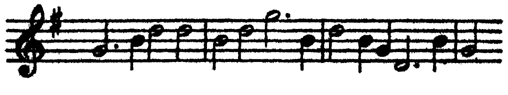
Only the oldest scholars, however, are likely to appreciate this. Simpler examples of wide leaps may be found in the school songs and their significance ascertained. The rise of the octave in *Caller Herrin'* has a rousing effect. The *Two Magicians* is full of leaps as one would expect in a song depicting a struggle. The *Marseillaise* may be contrasted with *God save the King* in this respect. The calm restraint of the English national anthem proceeding almost entirely by steps is a great contrast to the feverish excitement of the stirring French tune, which is full of leaps. The calm beauty of the Welsh song *Ar hyd y nos* (*All through the night*) is due to the close texture of the intervals. Something of this can be discovered by the children themselves.

The three chords, tonic  dominant  subdominant  will be sung to the tonic sol-fa, the notes first in succession and then sustained by different sections so that the whole chord is heard:



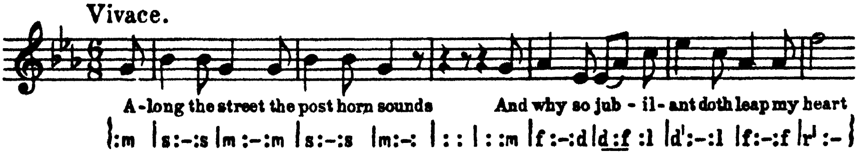
The sections will then change and interchange. The intervals will then be practised between the different notes of the chords in the most tuneful manner possible.

Examples such as the following can be improvized



endlessly. Sung to the tonic sol-fa names at first, or to *lah*, interest may be quickened by the setting of popular children's verses to them.

The bugle calls may also be used for the tonic chord. An exhilarating example of the use of the notes of the tonic and subdominant chords is Schubert's *Die Post* (*The post-horn*). The accompaniment opens with a variation on the tonic chord and then the voice begins:


Vivace.
A-long the street the post horn sounds And why so jub - il - ant doth leap my heart
:m |s:–:s |m :–:m |s:–:s |m:–: | : : | : :m |f :–:d |d :f :l |d':–:l |f:–:f |r' :–

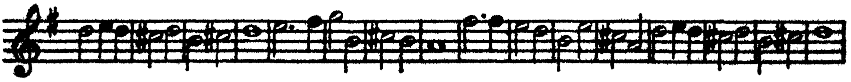
Any class would enjoy learning the whole song.

The staff notation will have been introduced in the upper part of the junior school, or, if not then, certainly in the first year of the senior school, and the relationship of the two notations explored. One great advantage of the staff notation is at once seen in the writing of chords. The exact spacing of the notes by means of the lines of the staff presents an immediate mental image of the position of the notes and therefore of the chord itself. The same observation applies to a melody in the staff notation the curve of which in its upward and downward flow is presented to the eye before it is sung.

While retaining the tonic sol-fa names for the scale the staff notation should gradually predominate. This entails the gradual learning of the key signatures beginning with C, and closely connected is the knowledge of modulation from one key to another. This is based primarily on the use of *ta* and *fe*, and these again necessitate the power to distinguish between tones and semitones, which should be consolidated by examples from songs learnt. At this stage the key signatures of G and F may be given, the rest would follow gradually.

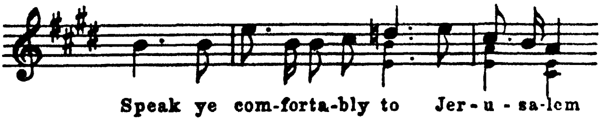
Let us start with the nearest related keys. If we are in the key of C the use of *fe* will bring us to the key of G, the dominant (*soh*), that is the key of one sharp. If we begin in the scale of G, the same process brings us to the key of D or two sharps, always to a key with a signature of one more sharp (or one less flat). Similarly from C, *ta* leads to the key of F, one flat, and so on. This should be demonstrated on the sol-fa modulator, the class being led from one key to another by a series of intervals.

A passage such as the following could be improvised for the class to sing:



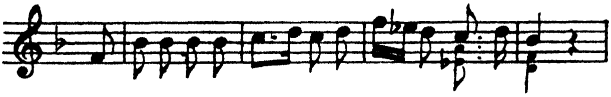
Some of the class probably would see without prompting that the first *soh* might be called *doh*, and the whole renamed accordingly. A sharp would be added to the signature in the C space and we have the key of D, two sharps, with *soh* of the previous scale G as its tonic note (*doh*).

The use of bridge notes will be noticed. They are not necessary in the staff notation although the transition from one key to another is performed in a similar way. The class will see that the additional sharp is always attached to the note below the new key note, and the additional flat to the fourth note in the new scale. This should be elicited from the class after examples rather than be told. Compare Schubert's *Haidenröslein* (*Rosebud in the heather*) and Handel in the first two numbers of the *Messiah*, at the words " Saith our God ", and " The glory of the Lord ". For tenderness of feeling, however:



which modulates from the key of four sharps to three.

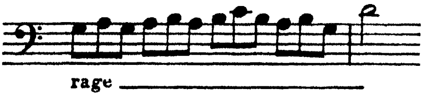
Schubert in " Gute Nacht " from the *Winterreise* cycle modulates thus:



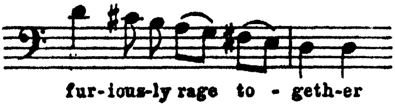
from the key of F to B flat.

This modulation by means of *ta* has a softening effect. It is the threshold of dominant seventh resolution and the principles of harmony.

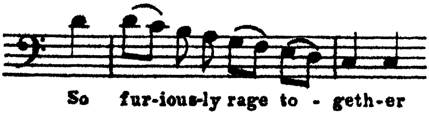
Continuing then with modulation that leaps over one or more related keys, it may be pointed out and shown on the modulator that when any note of the scale is reached it may be considered as another note in another scale. Thus Handel in *Why do the Nations*:



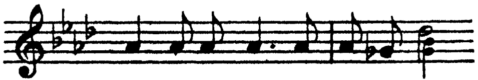
The last note D is *ray* in the key of C, in which the song is written, but the composer thinks of this as *doh*, gives us the harmony of the key of D, and follows it with the descending scale of D:



He then modulates into the key of G, works up to the note D once again, but this time comes down in the original key of C:

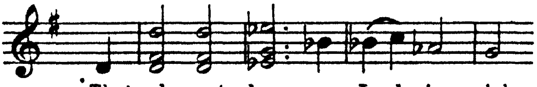


This descending scale in the original key gives tremendous force to the passage; but the whole song is a masterpiece. A soft modulation through two flat keys:

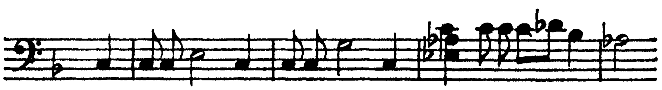


(*There is a green hill*, Gounod). Here the *doh* of the A♭ key has been changed to *ray* in the key of G♭ as shown by the harmony.

Wider leaps of transition than these are constantly found in modern compositions. In the tune by Walford Davies to *Hills of the North*, No. 67 in *Hymns of the Kingdom*,[1] we find:

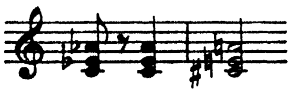


Here the dominant *soh* of the original key is transformed into *te*, and on the word " long " we have crossed four keys into the key of E♭. This is a modulation that is akin to a favourite form of modulation with nearly all composers since the time of Beethoven, that is transforming the tonic *doh* or dominant *soh* of the key in use into the mediant *me* of the key three or four flats away. So Sullivan in *Ruddigore*:[2]


And in-ky clouds like funeral shrouds sail o - ver the in - ky skies

from the Ghost Song, which the class would love to sing as a whole if copies were available. A similar modulation occurs in the middle of Beethoven's *Creation's Hymn*.

Wagner goes one better. In the first act of *Tristan* he goes through the whole seven keys in one beat:



The tonic *doh* of the first key becomes the *te* of the far-off key. As the words are " Vengeance for treachery ", the composer evidently thought that a violent bit of modulation was necessary. But this is very similar to the modulation in the hymn tune quoted above.

Such modulations would have been thought ungentlemanly in pre-Beethoven times. They are common enough now, and a senior class, if interested, would understand them. This is connected with the study of harmony. A composer not only thinks of a note in the scale as having another relation in another scale, but he has in his mind the surrounding

[1] Printed by kind permission. [2] Printed by kind permission of the publishers.

harmony, and senior pupils might advantageously practice detecting this. For example, the scale of C could be sung slowly, and on reaching G (*soh*) the chord of E♭ struck gently but firmly on the piano and the class questioned: " We are now in another key; what note in the new scale is the *soh* that you have sung?" The reverse process will of course be practised; that is, the class in singing a scale asked to transform or bridge any chosen note to the equivalent note in another scale. Some such practice as this is necessary to comprehend the constantly changing tonality of composers since the time of Wagner.

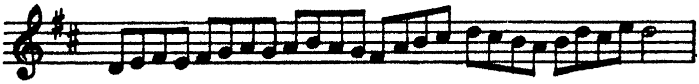
The reading at sight will now be carried farther, that is with wide leaps and slightly more elaborate passages. Phrases from tunes to be learnt can be read either from the printed copies or from the modulator (preferably the staff modulator), or from the blackboard; and then the whole tune.

Intervals sung or played, first singly and then in succession, will be named by the class or written down. Gradually phrases of several notes can be given for dictated ear tests. It is necessary to emphasize once again that writing down intervals heard is the only real ear test. In the early stages before this is done the class itself should sing the phrase if it consists of more than three notes. Interest will be quickened by dividing the class into sections and a competition organized in writing down the tests given.

Two-part songs will be introduced early in the senior school, and, later on, some in three parts. There is a wealth of both now available. Rounds are also stimulating. In learning a part-song the whole class might learn each part separately, and then divide and sing the two parts together, alternating with the parts. Smaller sections of four to six could perform it with the rest listening.

Pure contraltos are very rarely met with in young girls and boys. Later, an occasional one or two may be found whose voices have a distinctly lower range, and these would definitely form the core of a second or third part for school or public performances.

Exercises in flexibility can be practised at all stages. Examples may be endlessly improvised of the following type:

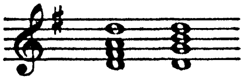


They should be sung to a broad open vowel such as *ah* or *oo*, and the notes must be separated from one another and not slurred together, or any such passage will sound a " smudge ".

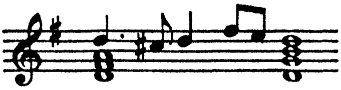
Arne's *Where the bee sucks* and Purcell's *Nymphs and Shepherds* are inspiring songs for such practice. The runs from some of the choruses in the *Messiah* or other Handelian oratorios are interesting in themselves, particularly " For unto us a child is born " and " All we like sheep ". The soprano and alto parts can be sung by themselves, both separately and together, but if the tenor and bass parts can be provided, the interest will be increased a hundredfold. The " Gloria " in Bach's Mass in B minor also gives splendid practice of this type. This and other choruses from Bach's great work have been performed by senior school choirs, the elder boys, helped by members of the staff, taking the tenor and bass parts.

In practising the singing of intervals the senior classes should gradually acquire the names: second, third, fifth, &c.; major and minor thirds and sixths; augmented fourth (*fah* to *te*, known in the Middle Ages as the devil's interval); perfect fifth; minor seventh, &c. The last is most important from its use in harmonic developments. The oldest classes, that is, those of 15 and onwards, can make a beginning of the elementary principles of harmony, and attempt to apply these for themselves.

The tonic chord, the dominant and subdominant chords have already been considered separately. They are also perfect concords, so-called. The natural progression is from the chord of the dominant to the chord of the tonic, and from this to the chord of the subdominant. Each of these constitutes what is known as a perfect cadence. In each of these progressions there is a note common to the two following chords, a valuable principle in harmony. The class may divide into four sections and sing the chords:



The latter is termed an inversion of the tonic chord, that is, with another note than the root as the bass. Or by inserting passing notes the progression could be varied:



Any other part might sing a phrase during the progression. Two phrases together would bring us to the border line of counterpoint.

The progression from the chord of the subdominant to the tonic chord, known as the plagal cadence, is commonly used for " Amens " at the end of hymns. It was an ecclesiastical formula in the Middle Ages, when the fathers of the church prescribed and laid down rules as to what was right and what was wrong in the musical writings of composers.

Each of the above three chords is composed of three notes a third above each other, and the octave of the bass note. The three notes are called a triad. A similar chord of four notes can be built on any note of the scale, but the chords on D, E, A in the scale of C (*ray*, *me*, *lah*) are minor chords, that is the second note is a minor third above the bass note. It should be noticed that the chord of the dominant will lead to the minor chord of the tonic as well as the major. This would be represented by B flat in the above examples instead of B natural.

Now let us take the first of the above cadences, and in the first chord instead of the top *soh* let us put *fah*, thus creating a discord. *Fah* in the scale starting from *soh* is the seventh, and as *soh* is the dominant of the key that we are in, we get what is known as the chord of the dominant seventh. The dissonance in this craves for completion or resolution, and such is found in the chord on the tonic. We thus get the dominant seventh or perfect cadence, the central point of all harmony, which seems to have taken some centuries to discover and develop, and which now forms the conclusion, either stated or suggested, in all musical compositions, and which rules more or less transitions during the progress of any piece.

By showing that the perfect cadence can be constructed so as to lead to any note in the scale, and then exploring the series of triads on the separate notes of the scale, first without and then with the 7th, the elementary principles of harmony might be studied with a senior class. After a few examples supplied by the teacher the class could try to suggest and then write a bass part to a given melodic phrase. The best attempts could be completed with inner parts by the teacher.

A melody of a few bars might then be supplied, and the class asked to write a parallel part above it. This is called a descant and offers great opportunities for the exercise of musical imagination. A great many descants to well-known tunes are now published. The Welsh Song Book has one to each number. The descant will not necessarily be always above the original melody, but it must be as melodious in itself as possible. This also applies to the parts in the harmonization of a melody.

Constant change of harmony is of course not necessary, when the melody alone is considered. Sometimes the effect aimed at requires a continuance of just one or more chords. Schubert in the song *Gretchen am Spinnrade* (Margaret at the spinning wheel) keeps the accompaniment going for bar after bar on the same chord, changing it very rarely. Wagner in the opening of the *Rheingold* keeps the orchestra for 137 bars on the chord of E flat, to represent the unvarying flow of the river.

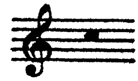
The staff notation, in contrast with the tonic sol-fa with its moveable *doh*, suggests a settled pitch for each note. This has now been fixed in conformity with continental practice at middle A = 435 vibrations per second. Some persons seem to acquire the conception of this pitch unconsciously. From the experience of the writer, a class may have its sense of this developed by practice. At the beginning of a lesson, before a note has been heard, the scholars may be asked to sing the note A, pointed on the staff modulator, to *lah*. It could be varied by asking them to sing A, B, C—*lah*, *te*, *doh*—or the reverse. They will be found in time to be fairly certain of hitting the right note more or less exactly. Of course the same note should be asked for.

Teachers of tonic sol-fa often give separate characteristics to the notes of the major scale and connect with them hand signs. One has heard praises of the system, but as it will largely have to be unlearnt later on it can hardly be recommended.

The fact is that the characteristics of notes are entirely relative to the phrase in which they occur, and composers give them an absolutely different flavour by association. Thus the greatest funeral march in the world, Handel's *Dead March in Saul*, is built on *doh* and the major scale with hardly a *lah* in it, certainly not a prominent one. Handel again constructs one of his most triumphant and joyous choruses on *lah* and the minor scale, " Great Dagon hath subdued our foe " (*Samson*). Beethoven, as if he wished to demonstrate this, in his trio for piano, clarinet, and cello, Op. 11, writes for the third movement an air with variations. The air is of a light jigging nature, but he makes one variation in the minor solemn and sad, and another, also in the minor, full of confidence and vigour. The carol *God rest ye merry, gentlemen* is also in the minor mode, beginning and ending on *lah*, and contains besides a number of *lahs*—the " sad " note, but it fairly bursts with " tidings of comfort and joy ", and Dickens uses it in this vein to stir up the miserable old miser Scrooge. Pupils will learn that emotional effects gather round a phrase rather than a note.

Musical Dictation.—The following are suggested lesson notes for the lower part of the senior school (ages 11–12). It is assumed that the class is familiar with the staff modulator, that they know the key signatures of C, G, F, and that individuals have had some practice in writing named diatonic sol-fa notes in the staff notation on the blackboard and on ruled paper, as well as reading them when written, and that they have sol-faed one or more of the songs learnt.

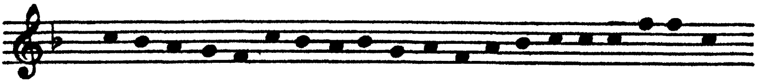
A rhythmical song not previously learnt is played on the piano. We'll suppose it is the *Bailiff's Daughter of Islington.* The class in imitation sings the first line to *lah* two or three times until well known, the other following lines, and then the whole song either to *lah* or any other syllable or vowel, with changes. Now the teacher asks if anyone can name the first note in tonic sol-fa. If there is no response he tells them it is *soh* in the scale and asks the class to name the first five notes. As they are in this case the descending notes of the scale, several will probably be able to name them, and then after singing the first line again the tonic sol-fa names of the other notes are elicited. If there is any difficulty the interval is sung by the class until the notes are discovered. The class then sol-fas the first line.

The teacher says: " I will write the first note in the staff  What is that note?" *Answer*: C.

Teacher: If C is *soh*, what staff note is *doh*? *Answer* (perhaps after a little calculation): F.

Teacher: This is then the key of F. How do I write that signature? *Answer:* With one flat.

Scale and chord of F on the staff modulator is pointed and sung. (Here a volunteer is asked to come and write the notes on the blackboard.) The class sings slowly to tonic sol-fa names the first line, while the volunteer writes the notes without tails, thus:

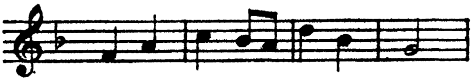


A second volunteer writes the second line and so on to the end. The whole tune is now sol-faed; a volunteer points out the notes as sung and the teacher taps the rhythm, giving an accent to the first note in the bar.

This probably would occupy one lesson. The next lesson would start with the notes on the blackboard as previously completed for the placing of bars and time values. The class would sol-fa the whole tune again and mark with a tap or a hand-clap the accented notes. A volunteer would then insert the bars after it has been elicited from the class that the accented notes come immediately after the bar lines. The class again sings the first line while the teacher beats time. The teacher asks: " Is it in two-pulse or three-pulse rhythm?" *Answer:* Two-pulse. The teacher writes the time signature $\frac{2}{4}$ provisionally.

As the first line is sung again, the class is asked to single out the notes which just occupy one beat. As they are named by the class a volunteer makes them into crotchets. Then those of which it takes two for a beat are made into quavers. In the early stages the teacher could himself write the dotted note and the succeeding quaver. If this is done in the first line the class might tackle the remaining instances. When completely written the song would be sung again. The class would then be asked to express their opinion as to whether it suits the song best to make the accents on the first of every bar equal or alternately strong and weak. If the latter, the time signature would be four crotchets in a bar, or

Now a simple exercise could be given to the class: a melodic phrase, either from another song or improvised, say



which is sung or played and repeated by the class on *lah*. They are told that the first note is *doh* in the key of F, and this is shown on the blackboard. They are then asked to write down the notes of the phrase at first without bars. In the early stages it will be better to let the class sol-fa any passage before writing it down. Later they can sol-fa it in their minds. The notes are then written on the blackboard, and those that have them correct asked to hold up their hands. The rest correct mistakes. After singing it once more they write in the bar lines, and verification is made in the same way. Lastly time values are shown by adding tails and converting the notes into crotchets, quavers, and semibreves.

Books of collections of melodies and melodic phrases for sight-reading that can be recommended are:

Master Melodies for Schools, Books 2, 3, 4 (staff notation), Wiseman and Wishart (Kerr); *Progressive Staff Reader*, Books A, B, C, D, Hunter and Walker (Ba.); *Fifty Steps in Sight-singing*, exercises in both notations, A. Somervell (C.); *School Sight-singing Reader: Elementary and Intermediate Grades* (either sol-fa or staff), McNaught (N.).

Hunter and Walker's four books contain an admirable collection of sight-singing exercises at a very reasonable price.

Kitson's book on *Elementary Harmony* (O.) in two parts is a reliable book on the subject for beginners.

CHAPTER IV

Time and Rhythm

This branch of musical instruction is very much more important than the usual teaching of it would suggest. Apart from such classical examples as the opening of Beethoven's Violin Concerto and the development of the latter part of the scherzo in the same composer's fifth symphony, an ordinary song is either stirred to life by its presence or rendered lifeless by its absence. With juveniles the impulses are there waiting to be kindled.

Mr. Jacques Dalcroze recognizing this has invented or inaugurated a system of approach to music through rhythmical movements of the body which emphasize the rhythm of the accompanying music, and at the same time by expressing the emotions of the mind—joy, sorrow, despondency, exhilaration, &c., develop and control such feelings, and bring the internal organization of our being into closer relationship with external nature. There is no doubt that the system imparts a more vigorous life to music, and thus promotes the interest and efficacy of its study, especially among the young. Those who have experienced the results of Dalcroze classes know its value.

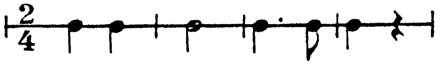
Education generally, and musical education in particular, would benefit greatly if the general practitioners among teachers, in junior schools especially, could acquire a working knowledge of the eurhythmic system and introduce it into their classes from the age of six onwards. It is not an alternative to drill and physical exercises.

Those who have experience in class teaching know how frequently it happens that a class with a good working capacity in reading ordinary melodic intervals will break down in sight-reading through inability to translate the written rhythm into actual expression. Only a clear perception of the whole on the part of the teacher, and the bringing of numerous examples of the varying details to the experience of the class, will overcome the difficulties and make the "rough places plain".

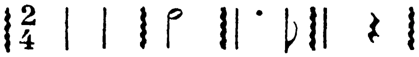
In this respect there is no gulf between instrumental and vocal music, but as the tonic sol-fa system is inapplicable for several reasons to the former, it follows that in the senior school this should gradually give place to the staff notation.

Some have found the time-names borrowed from the French useful to impress the different rhythmical divisions on the mind in the early stages. They are to be found in any book dealing with the tonic sol-fa method, such as that by Venables [1] or Field-Hyde.[2]

The class should have brought from the junior school some acquaintance with the elementary two-pulse and three-pulse rhythms, bars, time values of semibreve, crotchet, and quaver in the staff notation, and the dotted note ($\frac{3}{4} + \frac{1}{4}$ pulse). From the age of 11 it would be well to write all rhythmical patterns and exercises in the staff notation thus:

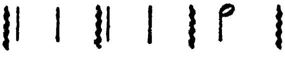


and then for purposes of speedy writing on the blackboard to accustom the class to the shorthand method, that is writing the tails of the notes without the heads. The above rhythmic pattern would be

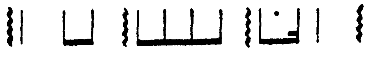


Wavy lines are used for bars to avoid confusion with the crotchet tails, and these tails are all supposed to be written downwards. For a while any rhythmic pattern to be studied could be written in both ways, and when the class are familiar with the shorthand method this might be used generally, and thereby much time saved. Let any pattern that is being considered be sung to *lah*, or any other convenient syllable, on one note, and then to the notes of a descending and ascending scale or part of it, as illustrated in the lesson notes at the end of this section, and then compared with a similar passage in a song that has been learnt, always with the rhythmic pattern on the blackboard. Variations of this pattern from the same song or another could be written by the teacher for comparison, or one of the class asked to come and write it.

If $\frac{2}{4}$ time is being studied a song would be learnt in this time, or one already learnt could be used, the bare bones of the rhythm exhibited:



and



and all the variations in the song shown in pattern, the class co-operating as far as possible. The same with other rhythms. In the following examples the skeleton is first shown, then a song quoted that can supply flesh and blood, and variations follow:

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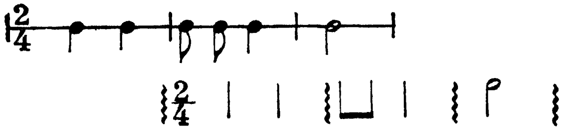
[1] Curwin. [2] J. Williams.

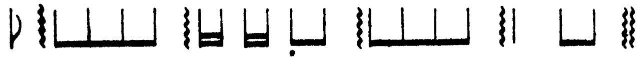
Common Time (2-pulse measure)

(*a*) Simple.—*Skeleton*:



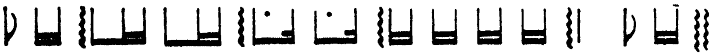
Song.—Farewell Manchester.

Variation (1)



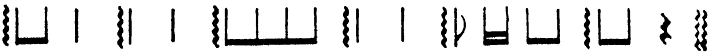
Lass of Richmond Hill.

Variation (2)



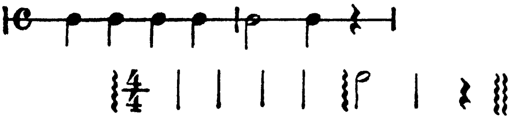
Joan to the Maypole.

Variation (3)



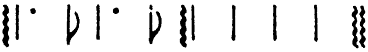
Sigh no more.

(*b*) Compound.—*Skeleton*:



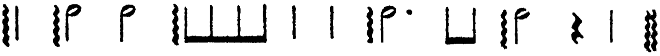
Song.—You Gentlemen of England.

Variation (1)



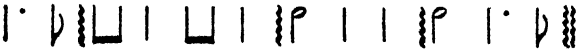
First bars of Men of Harlech.

Variation (2)



Rule Britannia.

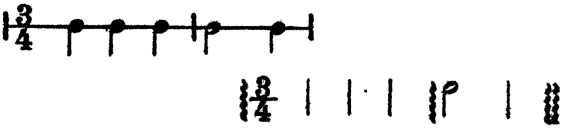
Variation (3)



Nymphs and Shepherds.

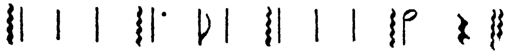
Triple Time

(*c*) Simple.—*Skeleton*:



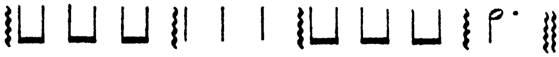
Song.—Golden Slumbers.

Variation (1)



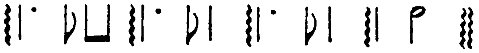
Robin Adair.

Variation (2)



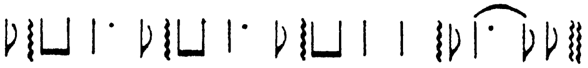
David of the White Rock.

Variation (3)



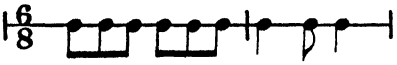
Here awa', there awa'.

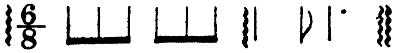
Variation (4)



Barbara Allen.

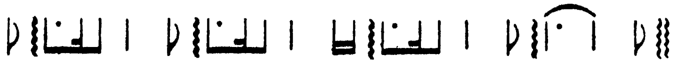
(*d*) Compound.—*Skeleton*:





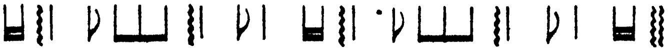
Song.—The Campbells are coming.

Variation (1)



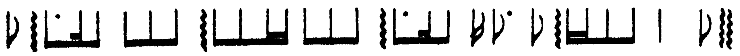
Come lasses and lads.

Variation (2)



The Hundred Pipers.

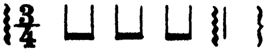
Variation (3)



Lament of Flora Macdonald.

Let some attention here be paid to the distinction between $\frac{3}{4}$ and $\frac{6}{8}$ rhythms. Mention will have been made that the lower figure of a signature refers to the basic common time of 4 crotchets, or 8 quavers, &c., in a bar, and the top figure to the number actually used in the piece with that particular signature. So $\frac{3}{4}$ can be read 3 crotchets instead of 4, $\frac{6}{8}$ as 6 quavers instead of 8, and so on. If the top number of the signature is divisible by 3, it is a triple measure: $\frac{3}{4}$ time must therefore be rendered in crotchet threes, and $\frac{6}{8}$ or $\frac{9}{8}$ in quaver threes.

Now to demonstrate to the class that although 3 crotchets are equal to 6 quavers, yet $\frac{3}{4}$ time is quite distinct from $\frac{6}{8}$. Write and let the class sing on one note to *lah*



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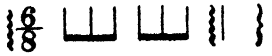
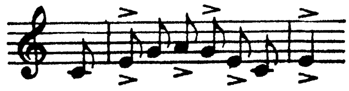
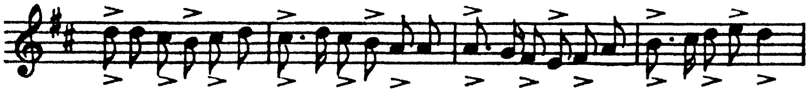


Now sing in both rhythms



first without and then with the preliminary C. Some of the class will probably recognize that in $\frac{6}{8}$ time it is the opening phrase of *The Campbells are coming*. If not, a few more notes of the song may be added before the title is named. Now let the class sing the words in the usual rhythm, and then try them in $\frac{3}{4}$ time: " The Campbells are coming ", which will be found impossible. The following may then be taken in both rhythms:

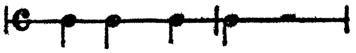


and the preference of the class asked for. Then the words of Moore's poem, *Go where glory waits thee* (National Song Book)[1] fitted to it, " Other arms may press thee, Dearer friends caress thee, All the joys that bless thee, Sweeter far may be ": when it will be seen that although the $\frac{6}{8}$ rhythm is not absolutely impossible, the $\frac{3}{4}$ is the natural one.

As large a number of examples as possible should be given to the class, and whenever any difficulty arises in the reading of a new phrase because of the rhythm, let the pattern of this be studied with several examples, either on one note, or on successive notes of a scale, or with a simple improvised melody.

Syncopation.—In the second and third years of the senior school there should be some study of syncopation. This is a breaking of the regular flow of the basic rhythm to prevent monotony and to impart greater vitality to the musical phrases. It is rarely met with in folk songs, where the first essential is an unbroken rhythmic swing. It adds enormously to the range of expression, and modern composers use it very freely, especially in instrumental compositions. It is very characteristic of Schumann, although he is sparing of it in his songs, where, if employed at all, it is relegated to the accompaniment. Hugo Wolf, one of the greatest of modern song writers, makes great use of it in the majority of his songs.

The commonest form is of the following type, common time:



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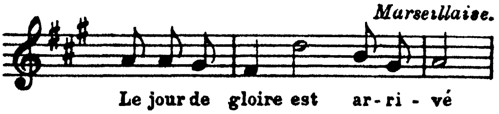
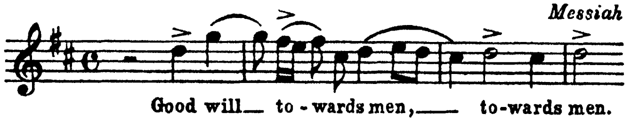
[1] Quotation from National Song Book, by kind permission of Messrs. Boosey & Co.

which throws the secondary accent from the third beat back to the second, and creates the sensation of a triplet. Milton does the same frequently in *Paradise Lost*, to vary the iambic measure. "Hìgh on a thròne of ròyal stàte", &c.

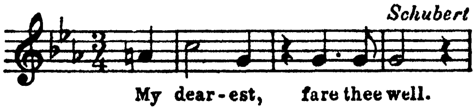


Feeling is stirred by the syncopation. It is very rarely found in Schubert's songs, but not infrequently in the accompaniments. The accompaniment of *Gefrorne Tränen* (Frozen tears) is based throughout on the pattern, with the second beat in the bar strongly accented. Somewhat more elaborate:

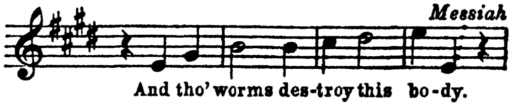


If Handel had been a native Englishman, he would probably have put this cross accent elsewhere than on the first syllable of the word towards.

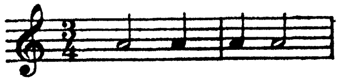
Sometimes by means of a rest,



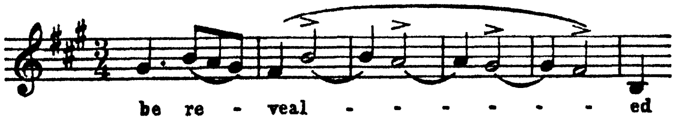
or



with a suggestion of common time



In the alto part of the first *Messiah* chorus we find:



This is an instance of syncopation leading to a cross accent, where the regular accent continues but another is made to fall, by syncopated notes, on other parts of the bar.

We have said that the rhythm of music is either two-pulse or three-pulse measure, common or triple time. Composers have, however, used $\frac{5}{4}$ and $\frac{7}{4}$ times, and there are some well-known examples of such rhythms. There is the famous second movement of Tschaikowsky's Pathetic Symphony.

Brahms has a beautiful melody in the C minor trio (Op. 101) written in a seven rhythm, although the composer divides it into bars of 3, 2, 2, and Hugo Wolf has written a splendid song, *Hunter's Song*, in $\frac{5}{4}$ time.

The study of syncopation and developed rhythms, touched on above, is naturally only suitable for the upper forms in central and secondary schools.

Tempo.—The rate or speed at which any piece of music is taken is a thing apart from the preceding time measures. Rates are generally designated by the Italian terms, from slow to fast:— lento, adagio, largo, larghetto, andante, andantino, moderato, allegretto, allegro, molto allegro or allegro con brio (Beethoven's favourite term), vivace, presto, prestissimo.

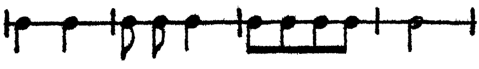
A mechanical but more exact way of marking the tempo is by the metronome, an instrument invented in Beethoven's lifetime. It is constructed so as to tick any number of beats per minute. Thus ♩ = 60 means that the metronome is set to 60 beats per minute and that gives the time of the crotchet. A hand-made metronome can be constructed by tying a small weight to a cord or piece of thread and letting it swing. 39 in. of thread will give 60 swings per minute, 22 in. give 80 swings, 14 in. 100 swings, and 9½ in. 120 swings; counting one swing from right to left or left to right, and not the whole swing to and fro.

The foregoing represents work that covers the whole school course of say 9 to 10 years, that is, from the age of 6 to 16 or 17. The first steps in the junior school will be to form a clear understanding of the use and meaning of bar lines, accents and pulses, or how the place of the accents is shown by the bar lines. All this will come from examples in the songs learnt, and may be further illustrated by the pronunciation of words, e.g. *quickly*, *singing*, *Johnnie*: all have an accented and unaccented syllable; while *jollity*, *threepenny*, *calculate*, &c., have one accented and two unaccented. Then will come the consideration of two-pulse and three-pulse measures, then divided pulses (½, ⅓, ¼ or the dotted note); notes sustained through two or more pulses; and silent pulses or rests. These will, in the first and second years of the senior school (11 and 12 years of age) be related to rhythmic patterns as shown above. They should never be unassociated with songs or melodic phrases.

Lesson in Rhythms—Simple and Compound

First Year: Senior School.—Recapitulation and extension of work done in junior school.

Let us be perfectly clear as to what we are aiming at in this year's practice and lessons. First, that the class as a whole should have a clear idea of two-pulse and three-pulse measures, and the effect of compound time as distinguished from simple time. Second, that the pupils shall have an idea how these are expressed in musical notation, so as to be able, on seeing a rhythmic figure, say

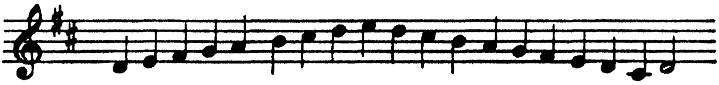


to reproduce it on a note, *lah* or *moo*, for example, with accents marked by taps or otherwise; and on the other hand to write down a simple rhythmic figure when heard; and later to join these processes with the notes of a melody.

It is of the highest importance that the class should have a large number of examples to practise both ways, but it is to be borne in mind also that the capacity of translating written notes into ryhthmic sound, and vice versa, will only develop very gradually. Real teachers will know that they must connect with the lessons all possible experiences of the young minds. The slow, the quick march, and the double, an engine puffing uphill, nursery or nonsense rhymes, or even limericks, &c., may all be represented in written rhythmic figures. Such will afford incidental illustrations, and bring life into the lessons. At the beginning of this year a thorough recapitulation will be made of the bar and values of the semibreve, crotchet, quaver, and the dotted note; these in connexion with songs learnt.

For developing the knowledge of rhythms, and the expression of them in musical notation, a method such as the following will be found useful:

The class sings a verse of a song in $\frac{2}{4}$ time, already learnt—*Farewell Manchester*, or something similar. The teacher then writes on the blackboard an ascending and a descending scale such as:



and the class sings it, without accent, to the tonic sol-fa names.

Teacher to the class. This is a line to hang the rhythms on, as we use a clothes-line to finish off clothes.

Next the class sing it, and the teacher taps the first, third, fifth, &c., notes. Again, tapping second, fourth, &c.

Teacher. I want to show by bar lines where those taps come. Give me another name for the taps. *Ans.* Accents.

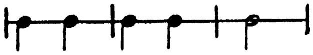
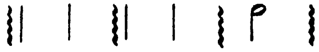
T. Where does the note come which has the accent? *Ans.* The first in the bar; or just after the bar line.

T. For the first way we sang the scale, where must we put the bar lines? Class sings it again in the first way. *Ans.* Before the first, third, &c., notes.

T. And for the second way? Class sings while teacher taps. *Ans.* Before the second, fourth, &c.

The teacher writes in a few bars in the first way, reminding the class that a bar line is never put at the beginning, and then rubbing these out (or a pupil standing by with a duster may do the rubbing out), writes in a few bars of the second way, the class singing as the bars are written.

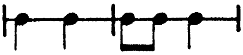
Teacher. This is the rhythmic pattern:

 or 

Sing this on the note I give you to *lah.*

The class now sings the first four bars again of *Farewell Manchester,* or of another song in $\frac{2}{4}$ time.

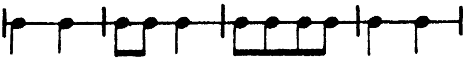
T. How are these notes different in time from the scale we sang? *Ans.* Some are quicker than others.

T. How much quicker? (Beats the first two bars  Class imitates.)

T. Now, how much quicker. *Ans.* Twice as quick.

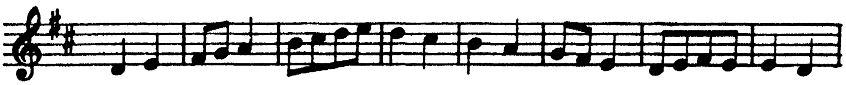
T. What are the twice-as-quick notes called? *Ans.* Quavers.

Teacher writes the pattern on the board

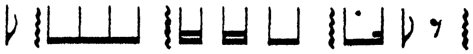


Class sings it to *lah.*

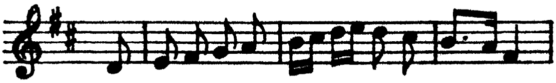
T. Now sing the scale to the same rhythm.



This is sung at first to the bare notes of the scale written on the board. The class will then show where the bar lines come and which notes are to be made into quavers. Various $\frac{2}{4}$ rhythms should then be written and sung to one note on *lah,* and also to the scale. Suggestions of different patterns relating to well-known songs have been made above. In addition to those, the *Rising of the Lark* and Schubert's *Das Wandern* (The wandering miller) are beautiful examples in $\frac{2}{4}$ time. The pattern of the latter in shorthand is



which, worked out on the scale already on the board, is

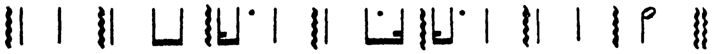


We drop to *me* or *doh* to get a resting-place. If this song is available, the class would sing the whole of it. It is necessary to see that both semiquavers get their due recognition, clear and detached, although sung to one note.

Good King Wenceslas will then serve for a four-pulse rhythm in a similar way. *Men of Harlech* will bring a variation of pattern. Others have been mentioned above. All these can be treated in the same way, first the song, next the rhythmic pattern on *lah* (shown in shorthand), then the same fitted to the double scale, the end being adapted, and then the song from the printed copies where available.

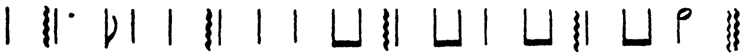
The rhythmic patterns might then be written of well-known verses, e.g.

Old King Cole was a merry old soul



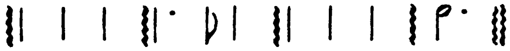
and the pattern transferred to the double scale.

It was a lover and his lass,
With a heigh and a ho and a heigh nonny no

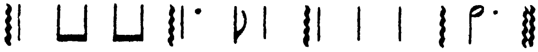


Transferred to the double scale, this just fits if two dohs are sung at the beginning. Arne's setting could then be sung. The class should now be tested by the writing of melodic phrases on the board (or from a book), sol-faed first without rhythm and then with time values.

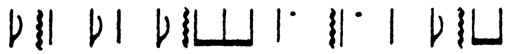
We now come to three-pulse rhythms or time measures. We start with *Robin Adair*, tapping the accents. The double scale with top *ray* and bottom *te* as written before will just fit a three-pulse rhythm. This could be varied by descending first and then ascending. The pattern of *Robin Adair*:



which is repeated twice, and then comes the completion, which is a variation of the first phrase:



For the compound $\frac{6}{8}$ *A frog he would a-wooing go, Heigh ho, says Rowley*, gives us as pattern:



Starting with two *dohs* on the ascending scale this gives us an interesting scale figure. *The Two Magicians* in Cecil Sharp's Collection of Folk Songs is delightful, rhythmically as well as melodiously. *Drink to me only* is another. Further examples have been quoted before. The class should practise and see the written pattern of as many as possible.

We now write the rhythmic pattern of lines such as *Old Mother Hubbard*, &c., and transfer to the double scale, with the end adapted. (The double scale could be varied by any other simple succession of intervals which the class can sing easily.) Take her up tenderly, Lift her with care, Fashioned so slenderly, Young and so fair (Hood). With two top *dohs*, this will fit the double scale. The Assyrian came down like a wolf on the fold, And his cohorts were gleaming in purple and gold (Byron).

After a number of examples have been sung, the class will have noticed that bars of compound time can always be divided up into two or more bars of simple time. Remembering that waltzes, dance tunes generally, and the scherzi of sonatas and symphonies are invariably in simple time, they will probably perceive with very little prompting that simple time gives a more emphatic and vigorous rhythm than compound time, but that to represent moods of contemplation, thoughtfulness, peace, and calm, a rhythm is needed where the main accent does not return too frequently.

In transferring poetical rhythms to musical notation it must be noticed that a two-pulse poetic rhythm is often set to a three-pulse musical measure, e.g. *There was a jolly miller*, &c., *I know that my Redeemer liveth*, and vice versa, although dactyls and anapæsts are usually suited with a three-pulse measure. *Old Mother Hubbard*, *And they went to sea in a sieve* (Lear), would categorically demand a $\frac{3}{8}$ or $\frac{6}{8}$ measure, the first $\frac{3}{8}$ and the latter $\frac{6}{8}$ probably as being thoughtful.

Accompanying these exercises there should be practice in sight-reading of simple examples from a book of sight-reading exercises. The class will only by degrees obtain facility in reading the intervals and the rhythm simultaneously. If they fail at any particular example let them practise for a minute or two on one note to *lah*, the pattern of the rhythm and the intervals separately, and then join them together. They will have in this way the satisfaction of solving the problem themselves.

CHAPTER V

The Technique of Singing

Singing is the all-important centre of school music, from which all other activities must radiate. Theoretical instruction, intelligent appreciation of the performance of music, instrumental developments among the scholars, are all important, but the bedrock, the foundation of the whole structure must be singing, either in groups, classes, choirs, or by the whole school.

Juveniles sing naturally, and their voices develop naturally. But between a trained and an untrained choir there is an immense difference in quality of tone, in musical renderings, and certainly in the individual understanding and appreciation of the work done. It is therefore essential that teachers of singing should have some knowledge of the principles

which govern the practice and development of singing among juveniles, if this is to be a living thing.

Every human being possesses a wonderful vocal organ of threefold construction. There is first the motive power, the lungs, providing the current of air and controlling its emission. Secondly, there are the two vocal cords acting like the reed of an instrument or of an organ pipe, and vibrating at will more or less powerfully under the pressure of the passing current of air. Thirdly, there is the resonating chamber formed by (*a*) the mouth, (*b*) the cavity above the larynx—both assisted by (*c*) the nasal chamber; the whole varied and changed by movements of the lips, the teeth, and the tongue; changes which produce the various vowels and consonants, and add meaning as well as beauty to the sounds produced by the vocal cords.

In an orchestra, different vowel sounds are produced by different instruments; for example, a trumpet gives out the sound of *ah*, the flute that of *oo*, the oboe a nasal *ă*, and so on, but each person carries an orchestra in his mouth, and the purity of the various sounds can only be attained by practice and training. A composer uses a trumpet, a flute, a violin. If he were offered an instrument that was a mixture of the three he would refuse it. So singers must have pure tones and no mixtures. The three important things always to be borne in mind put briefly are (1) breath control, (2) voice production, (3) clear articulation.

Breath Control.—This is a matter of knowledge of the principles of correct breathing, and practice in management of the breath. For healthy breathing the lower part of the lungs must be used as well as the upper, and this can be felt (but should not be seen) by the movement of the diaphragm and the lower ribs. The shoulders must not be raised.

Classes of all ages should be practised in slowly drawing long breaths, and at the same time the scholars should feel the diaphragm and lower ribs moving. After holding this breath for a second or two they should emit very slowly. The emission can be directed by the teacher, by the gradual moving apart of the hands. The outbreathing should be done silently and also on a sustained note, but in controlling the breath there should be no constriction of the throat muscles, or raising the base of the tongue. This practice should be carried on from the earliest to the latest school age. Elders will be reconciled to a practice that they carried on as juniors by the knowledge that it is likely to improve their general health and physical powers, and even make them better footballers. This may be claimed for deep, steady, controlled breathing.

Pronunciation of Vowels.[1]—Next comes the clear and distinct pronunciation of vowels, to add purity to the vocal production. The first three to be considered are *ah*, *oh*, *oo*. Of these the first, *ah*, is of special importance, because, when properly pronounced or sung, the vocal passages are all open and clear. Our climate militates against its pure production, especially in the north. Fog, mist, inclement skies, and winds counsel us to open our mouths as little as possible, with the result that vowels which require an open mouth and throat for their utterance are little heard. *Ah* tends to become *ă* as in cat, *ōh* to become *aw* or *ŏ*, or something between, and *oo* to be shortened as in foot. In the south of England one usually hears a more or less open *āh* in a word like *castle*; in Scotland the *a* is the same as in *hăt*. The less the open *āh* is heard in any district the more important is its practice with juveniles. For its *correct and healthy production, the mouth should be well open, the tongue flat at the bottom of the mouth, and the throat quite clear* (recall the trumpet); the vocal cords should feel quite easy and unforced. The teacher should be on the watch for the throaty sound of *aw*, which is caused by raising the back of the tongue and partially closing the passage.

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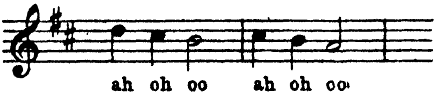
[1] In the matter of instruction in phonetics, the music teacher might with advantage collaborate with the English teacher. The former is of course more concerned with practice than theory.

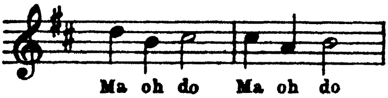
The sound of *oh* is produced similarly but with the lips partly rounded, with which is associated a slight raising of the base of the tongue. The tongue is still mainly flat and the throat passages clear.

The sound *oo* is produced by completely rounding the lips, which gives the mouth the flute shape. The base of the tongue is again slightly raised.

These three sounds should be practised together with jaws well open. The scale can be sung on each vowel separately, with or without a consonant in front, as *lah*, or the three vowels slowly and carefully on each note. Variations may be improvised such as:



and so on down the scale and reverse. The lips must be freely moved, but the jaws kept open. For a change one could substitute syllables:



There remain the two long vowels *eh* (*a* in *hate*) and *ee*. For these the tongue is raised until, for the vowel *ee*, it is near the palate, and the lips are elongated. The sound of *ee* resembles that of the top string of a violin. For the vowel *eh* the edges of the tongue will touch the top teeth, while for *ee* the tongue is raised to the extreme forward position. The elongation of the lips should be slight, not so much as is used for a French *i*, which becomes less pleasant in singing, especially in children, whose voices are naturally inclined to be thin. The jaws should be kept well open.

This gives us the five long vowels, which need very careful distinguishing. Considerable licence is allowed in English speech in the matter of distinction of vowels, in fact far too much. An enormous amount of misunderstanding would be saved if young people were consistently practised in vowel pronunciation. The strongest as well as the weakest language would be improved. In singing, however, it is all-important, both for the beauty of the sounds as well as the clear conveyance of the sense of the words, although here the consonants play a very important part. If the five vowels are practised in the order *ee*, *eh*, *ah*, *oh*, *oo*, or the reverse, we have a regular succession of movements of lips and tongue. *Ah* is the most open, and should get the most practice, but care must be taken that it is open and pure, and not throaty. The practice of the voice on the vowel *ah* will not only help towards vowel purity, but also towards the fuller power which comes from clear and unchecked resonance. These vowels may be monotoned, sung on the scale, or on the notes of the tonic chord.

The long vowel *aw* heard in *dawn* and *or* lies between *ah* and *oh*. It often tends to become what is called a throaty sound, especially in the north of England. This is caused by raising the base of the tongue. For purity of production the tongue and palate should be nearly as in the position of *ah*, with the mouth open.

The short vowels and diphthongs also need careful study. An excellent exposition of their proper production will be found in Aikin's article on Singing, in Grove's *Dictionary of Music*.

If these vowels, especially the long ones, can be practised for a few minutes at a time, and the class interested, it will help in the prevention of flat singing. The principal cause of this is apathy and listlessness, and indirectly those things which produce weariness, such as bad ventilation, remaining in one position, &c. Undue repression for the sake of soft singing often produces flatness. Fear caused by nervousness has the same effect. But every nuance is obtainable if the efforts of a choir are enlisted in the production of pure tone, which means pure vowels.

The singing below a note on the limit of the range has of course another cause. If such a note cannot be sung softly it should not be sung at all, until it is reached gradually by scales or octaves or other devices.

Sharp singing is mainly the result of an imperfect ear coupled with superabundant energy. As one sharp singer may infect a class, it is important to watch for any culprit. Forcing the voice, which also is the origin of the abominable vibrato, must not be countenanced. Full, whole-hearted singing can be obtained without it, but the foundation must be the pure production of the vowels.

Pronunciation of Consonants.—There remain the consonants. These are not sounds in themselves but modifications of vowel sounds, except in the case of the hisses, *s*, *x*, *z*, *sh*, and the nasal sounds *n*, *ng*, *m*, where the nose cavity alone is used for resonance, the mouth being closed by the lips (*m*), the tongue against the teeth (*n*), or the base of the tongue against the palate (*ng*). This the class should test by producing a prolonged example of one of them and then closing the nostrils with the thumb and forefinger. But these, like all the consonantal sounds, can only be musically uttered by the association with a vowel, before or after.

First we have the stops, that is, the letters which close a vowel sound by (1) shutting the lips, (2) putting the tongue against the teeth, (3) the base of the tongue against the palate; and they are consequently termed labials, dentals, gutturals—names which do not matter much. Further, some stop the sound at once, *p*, *t*, *k*, accompanied by a slight explosion before or after; others are accompanied by a murmur: *b*, *d*, *g*. Let these be practised and even exaggerated. At the end of words they must especially be heard. *Tip-cat* or *patacake* gives us the explosive three; *bed-rug* or *bad dog* the murmured three.

Let the class repeat a phrase such as *Lead*, *kindly light*, *amid the deepening night*, bringing out forcibly the *t's* and *d's*, then intone it on a single note, and then sing it to any tune. Here is a collection of labials: *Up, rob the ruby grape of beauteous Proserpine*; and with gutturals: *The cuckoo goes to attack the corncrake's egg* (or the birds might change places).

M, *n*, *ng* need the same agents for their utterance (lips, teeth, tongue, palate), but are prolonged by the use of the nasal cavity. With *l* there is an escape of breath on each side of the tongue which brings it within the category of hissing sounds if prolonged.

The consonant *r* tends to disappear in English speech, but Scotsmen wisely give it due prominence. The Scottish pronunciation of *Aberdeen* with a trilled *r* is pleasanter in every way, as well as infinitely more distinct in its conveyance of the whole word, than the slovenly English pronunciation tending towards *Abuhdeen*, or, with a "swagger", *Abāhdeen*. The letter is produced by the tip of the tongue, and is easily developed by practice in youth into a pleasant trill, which is valuable in singing, because the sound is then heard, and pleasantly heard. In singing lessons in England something may be done to prevent the extinction of this useful and innocent consonantal sound.

The hisses, whole or partial, are *f* and *v* (partially labial), *th* (partially dental), and the uncompromising *s*, *z*, *sh*. We have unfortunately an undue amount of these in English, as our plurals (with one or two exceptions) and the third person singular of our verbs are formed thereby. Poets avoid them as far as they can, probably from instinct, and a line of poetry without a hiss is the more comforting to the heart and appealing to the mind by reason of their absence.

Such are the bare bones of the language of singing. Melody and rhythm are the living flesh. Both need all the care that can be bestowed on them. This skeleton basis should be completed during the first two years in a senior school, given in small doses, and illuminated and made interesting by whatever living connexions and references the teacher can supply. In particular, lines of poetry known to the class or nursery rhymes or even doggerel may profitably be used as illustrations of the use and value of letters.

In subsequent years recapitulation should take place, and the foundations already laid consistently strengthened until clear consonants and pure vowels become by custom a second nature. For it is necessary to remember that singing has to deal with poetry as well as the musical setting. The sounds here treated are the pigments of the poet and wonderful are the pictures painted by their aid.

School Choral Possibilities

Realization is gradually dawning as to the wealth of choral opportunities in schools of the central and secondary type. One or two of the larger public schools have shown that the greatest choral masterpieces are attainable by school choirs. Oundle has made itself famous by repeated renderings of Bach's mighty B minor Mass. Other schools have followed suit, and one hears also of difficult modern works, such as Brahms' *Requiem*, being performed with great success by a public school choir. These schools have the advantage of keeping their boys up to 18 and 19 years of age. From this older section an exceptionally fine body of tenors and basses, especially the latter, is obtainable, and reports tell of the thrilling effect of the great Sanctus of Bach's B minor Mass thundered out with some 300 bass voices laying the foundations.

But if the other secondary or central schools cannot command these male voice resources, in the mixed schools at least the glory of the elder girls' voices will more than compensate in the treble and alto sections. As comparatively few boys in these schools stay to the age when their voices have definitely settled, it is unlikely that a strong male-voice section can be enrolled from them. If these, however, as a nucleus can be strengthened by members of the staff and a few parents and friends, a school choir can enjoy the glory of the greatest choral works, and bring this enjoyment to their friends and neighbours as well as the school. The choir of one county secondary school of North Wales (Hawarden), after performances of *Hiawatha*, *Golden Legend*, *Elijah*, several of the *Messiah*, along with some smaller cantatas, has included in its last four concerts performances of Brahms' *Requiem*, Elgar's *Dream of Gerontius*, Brahms' *Song of Destiny*, Parry's *Blest Pair of Sirens*, and as a climax in March, 1929, Bach's Mass in B minor. Liverpool and Chester critics have spoken in terms of the highest praise of the renderings by this school choir. The orchestra exercises a magical effect on these young enthusiasts.

The junior boys of Latymer School have given some remarkable performances of Mozart's *Magic Flute*, under Mr. Cunliffe, who had achieved similar results with boys in Yorkshire. Mr. C. Smith in his book *Music and Life* describes productions of the same kind by boys of an elementary school in East London.

It will probably be many years before such work becomes general in any type of school, but there is the possibility. The foundations, however, must be laid with the youngest, and the building must be carried upwards without a break to the oldest.

CHAPTER VI

Melody and Composition

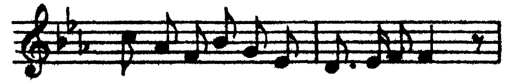
The ability to write down a tune conceived in the mind should be equally a part of a general education as the writing of a sentence to express an idea. The steps analogous with those of language teaching are: (1) learning and singing songs, (2) reading music from either notation, (3) musical dictation, (4) balancing and completion of musical phrases, (5) analysis of tunes, (6) harmony and composition. The last three can be carried on simultaneously as in the analogous branches of language instruction. A prime necessity is the enthusiasm of a gifted teacher. The supply of such will continue to be scanty until training colleges and universities afford a deepening musical culture on the one hand, and local authorities lay greater stress on musical capacity in at least one member of the staff of each school.

Beginning with the construction and balance of melodies, let us take a very simple case, the short but lovely tune of *Barbara Allen.* Here the melody rises gradually in a double curve from the lower to the upper *doh*, and the response is a similar descent to the lower *doh.* It is an instance of how beauty can be associated with the simplest materials. The *Bailiff's Daughter of Islington* has a similar outline. The ordinary folk song goes a step farther than this. Take as an example *The British Grenadiers.* The first phrase is started and ends with a full cadence. This is repeated, and then the answering phrase appears with a much wider outlook and ends with an imperfect cadence or half-close, and this leads naturally to a repetition of the opening phrase. Thus we have the tune structure known as AABA, the skeleton of a large number of folk songs and traditional tunes. Examples are: *Begone, Dull Care, There was a Jolly Miller, Robin Adair, Vicar of Bray, Drink to me only.*

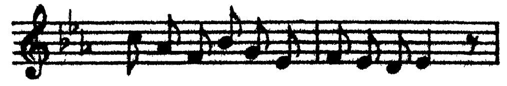
The answering is always interesting. Some sort of contrast or balancing is necessary; for example, after the pathetic opening of *Caller Herrin'*, suggesting a street cry round a monotone, we get the startling rise of an octave and the sweep right down the scale, stimulating to every listener. *The British Grenadiers* opens with a steady march-like refrain, while the answering phrase soars farther aloft in the scale, and is lighter and more rhythmically free in every way.

When A ends in an imperfect cadence the repetition is often finished with a complete cadence, as in *The Spring is coming*:

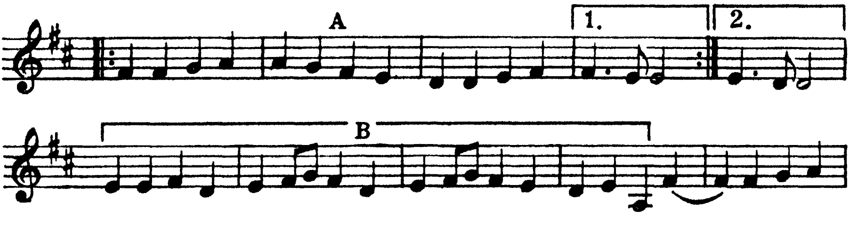
first statement



repetition



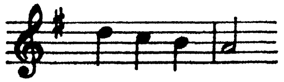
which adds variety and suggests a half-way house. The reverse is also found. Beethoven, when he writes his great choral melody in the 9th Symphony expressing his all-embracing love to mankind, adopts this folk-song form, probably instinctively:



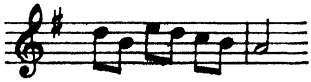
then follows a repetition of starting theme A, with complete cadence.

Is it possible that the answering phrase B does not fulfil expectations and is the real cause of the adverse criticism of this tune that one sometimes hears? There is so much beauty and inspiration in this symphony, and the outlook is so wide and sweeping, that one hesitates to question the perfection of a single bar.

If AABA is the most common form of folk song, we find also fairly often ABBA, where probably the original composer delights more in B than in A. Surely the loveliest of those in this form is the Irish song *My love's an arbutus.* The repetition of B in this is most delightfully varied by passing notes:

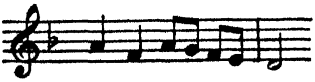


becomes in the repetition

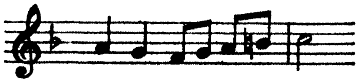


Those old composers had stores of magic at their command, although their names are now forgotten. Other examples are: *Lay his sword by his side*, and *The Harp that once through Tara's Halls.*

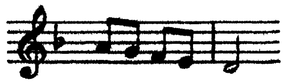
Differing examples of variations will be found. *The flight of the Earls* is very interestingly varied. A in repetition ascends to a half-close instead of descending to *lah* as in the first statement:



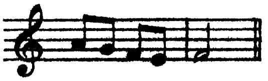
becomes in the restatement



and then after soaring freely the answering phrase B just suggests the first ending of A, reproving as it were the jaunty second ending, and then A comes back, but ending with a full close instead of the minor ending in the first statement: that is



now becomes the dignified



and stamps the conclusion.

The essence of the construction is that (1) the melody makes a start or an adventure conditioned by the general feeling of the verses to be illustrated, with or without repetition, (2) an answering phrase with or without repetition, and (3) completion is formed either by repetition of the first phrase, or another in keeping with the rest with complete cadence.

With new songs the whole tune might be played at the appropriate tempo to the class, and then their opinion asked as to its general character, exemplified by broad descriptions such as: cheerful, sad, bold, lively, thoughtful, dance-like, &c. Awakening of thought should accompany the stirring of feeling.

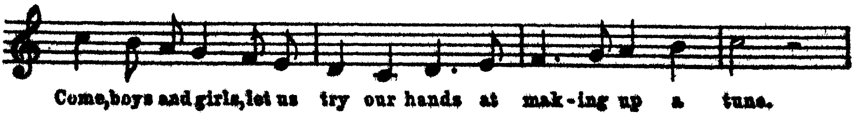
Melodies set to poetry with a wider range than that of popular verses, or to no words at all, will have a freer form of development, but the underlying principles will be the same: starting thought, reply, completion. At the same time the music must follow the words in a poetical setting, and the musician's art will be largely governed by that of the poet.

But to come to the main question, how a class can be brought to try their powers and to unfold their wings. It would be quite hopeless to tell a class of juveniles to try and compose a melody, or even to supply an answering phrase to one already given. There may be a juvenile Mozart in any class, but in the case of Mozart we don't know what steps his organist father took in his early years to initiate him in the writing of music.

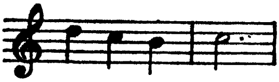
There are strong arguments in favour of making the foundation rhythmical. A succession of notes without rhythm is meaningless. Let the class sing the notes *m*, *d*, *d*, t_1, *d*, l_1, l_1, s_1, *d*, t_1, *r*, *d*, *m*, *s*, *m*, equally and without accent. Probably they will not recognize that the notes are those of the melody of *Who is Sylvia?* We suppose this is known to the class. On the other hand *The heroes of the Sea* (National Song Book) is nearly throughout a rhythmical setting of five-finger exercises. Mention has already been made of how Beethoven has converted a descending scale with a return to the dominant into the lovely melody of the slow movement of his fourth Symphony. In making such a rhythmical beginning it is assumed that the class has become thoroughly acquainted and familiar with the various rhythmical types referred to in the chapter on TIME AND RHYTHM, in two-pulse, three-pulse, and four-pulse measures.

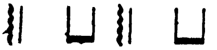
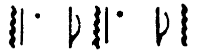
Now for a start with the class. Each member will have a piece of paper or MS. book for writing in tonic sol-fa, or better, if familiarized with the staff notation, having the lines of the staff drawn.

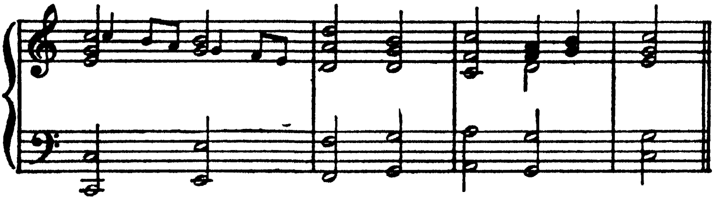
First we write on the blackboard, which should be provided also with lines, a descending and ascending scale (notes only at first):


Come, boys and girls, let us try our hands at mak-ing up a tune.

The class sol-fas it with equal notes and without accent. We now write bars and sing it in two-pulse measure with the accents on the first, third, &c., and then on the second, fourth, &c., notes. In the latter case a top D (*ray*) might be inserted before the final *doh* to make the accent come on the last note. Or, after rubbing out the first series of bars, the class could sing it, and one of the class insert the bars. Then the same in three-pulse measure. If the initial note is the first in the bar some finish will be necessary such as:

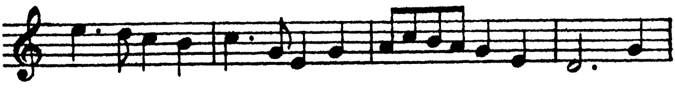


Now let us take one of the simple rhythms  and sing the double scale in this pattern. The first two bars alone need be indicated as examples for the rest. Here the same finish as just suggested may be added, or perhaps a member of the class may suggest another. Now with a dotted note . Next with a mixture of the two. We might now arrive at something like the above, where the descending and ascending scales are barred in common time. A sentence is suggested to fit the notes, but a suggestion from the class would be preferable. We have now something approaching a tune. If the teacher would accompany with some simple chords as the class sang it slowly, the approach would be more convincing. For example:

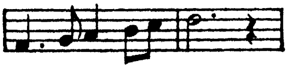


After rehearsing on a monotone some of the rhythms already practised and applying one or two to the double scale, the class might try and arrange the double scale for themselves in the rhythm that appealed to each individual, with a suitable ending, either during the lesson or out of school. After investigating the results the teacher would select the best, play them, and let the class sing them either to a syllable such as *lah*, or to improvised words.

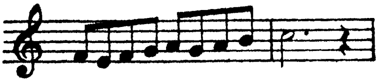
The class will have recognized that all that has been done so far has been to use a down and up scale with varying rhythms or time measures. They may give their opinions as to whether the result arrived at is a tune, the start of a tune, or merely an approach. Would it do for a folk song if repeated, then answered and completed? For an answering phrase of the first arrangement one would have to go outside the scale. Here is a suggestion:



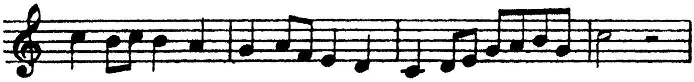
The first theme would then be repeated, to complete. In order to vary the monotony, at the first repetition of A the ending might be



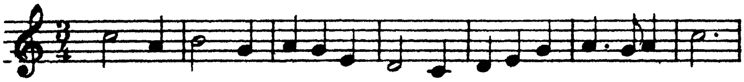
and for a finish something of this kind:



The next step would be the varying of the up and down movement, and the introduction of thirds, with the double scale still in mind. The teacher could give as an example some such phrase as this:

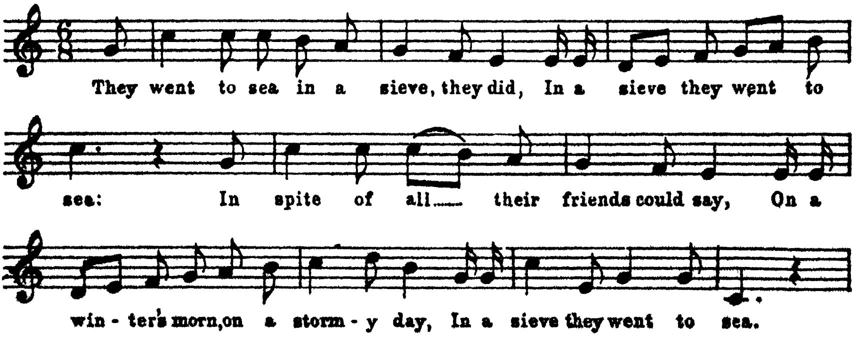


or in triple measure:



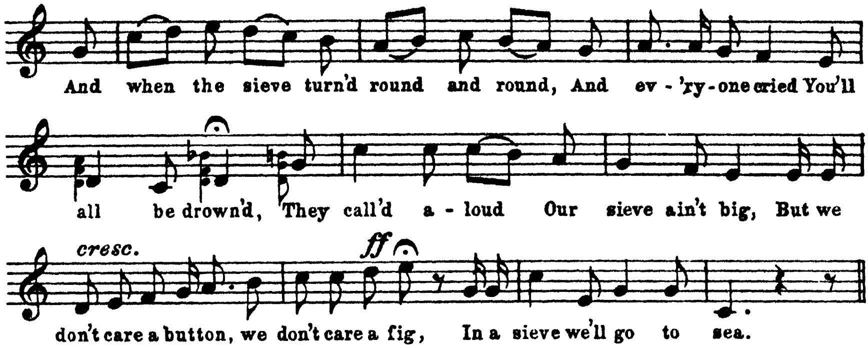
which is in the pentatonic scale.

If the class is not yet certain that a real tune has been arrived at, an expansion of the double scale in triple time might take place in this way:

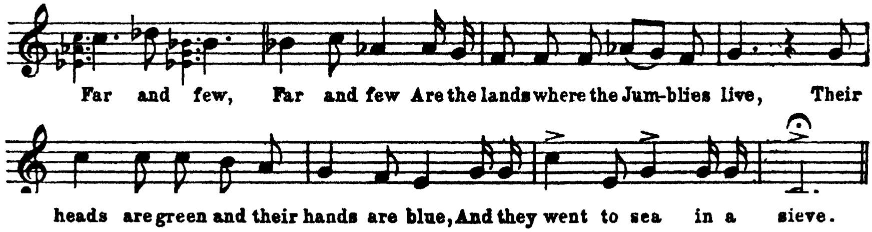

They went to sea in a sieve, they did, In a sieve they went to
sea: In spite of all their friends could say, On a
win - ter's morn, on a storm - y day, In a sieve they went to sea.

This would be A repeated and concluded with the notes of the tonic chord and a full cadence. Lear's soul-stirring words have been used to hang the refrain on to.

The class would like to try an answering B. The teacher will have one in reserve. Here is a suggestion:


And when the sieve turn'd round and round, And ev - 'ry-one cried You'll
all be drown'd, They call'd a - loud Our sieve ain't big, But we
cresc.
ff
don't care a button, we don't care a fig, In a sieve we'll go to sea.

As a coda with an exercise in modulation, and to finish the verse, one might add:


Far and few, Far and few Are the lands where the Jum-blies live, Their
heads are green and their hands are blue, And they went to sea in a sieve.

The teacher would add chords and any additional accompaniment that occurred to him.

For several lessons it would be necessary to have a series of notes to work on. A double ascending and descending scale would vary the foundation, or the pentatonic scale, or the scale from *doh* to *lah* ascending and descending. An example of this is the previously quoted Hungarian song *Far and wide the cranes do fly*, which is entirely based on these notes and their transposition a fifth higher. This latter sequence would supply a hint as to the carrying on of a tune after the beginning such as Schubert is very fond of.

The folk song *Barbara Allen* can be quoted as an example of a tune constructed on the skeleton of an ascending and descending scale. As many examples as possible should be quoted from the songs already learnt, as after all the writing of tunes, like the writing of sentences, will be the arrangement of material already in the mind. Originality is merely a rearrangement of such material, and that is only likely to happen long after school years.

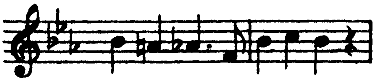
When the class, or the majority, has been led to make some attempts at melody writing examples may be supplied of melodic phrases to be answered. This usually needs either a contrast or a development of the first phrase, and is a more difficult matter. All possible illustrations from known songs should be shown and sung. Here are a few types of answer:

(*a*) Ascending phrase answered by one descending, *Barbara Allen*; and vice versa, *The Girl I left behind me.*

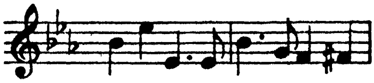
(*b*) Melody in steps by one in leaps: *Caller Herrin'.*

Here is a notable instance of this from Hugo Wolf's *Verborgenheit*:

Opening phrase



answered by



(*c*) A quiet stay-at-home answered by one more adventurous, as *Drink to me only.*

(*d*) A stirring opening answered by gloom, as *The Bay of Biscay.*

(*e*) Minor answered by the major, as *God rest you merry, gentlemen*; and others.

All these imply something in the nature of a contrast, and understanding of them with young people will only develop very slowly. As long as the songs studied are sung by them and they take part in the exploration and analysis of these, so will their comprehension and appreciation grow. Only those in the senior classes are likely to be able to make attempts with success at this building. The skilful teacher will feel how far his class is marching with him, and will only offer an explanation when the pupils are on the verge of discovery for themselves, and then he will assist their perception by suggestion rather than by supplying information.

At this stage we are but on the threshold of the great art of melody construction. There are numberless ways in which a theme may develop from itself, particularly the big instrumental subjects. Schubert's *Serenade* is an example in which the first melodic statement is repeated with an ever increasing warmth of utterance up to a climax and then sinks to an expression of melting tenderness. Other forms of melodic development will be found in the masterpieces of music.

This does not touch the two contrasted and complementary themes in a symphony or sonata first movement, nor the bevy of themes grouped round the principal one in a rondo. They will be explored and absorbed in appreciation lessons.

This is the road along which a class may march a little way. If there are vistas opening before them in the distance and they are kindled to further exploration on their own account, their lives will be greatly enriched.

CHAPTER VII

School Orchestras

Every senior school—central or secondary—should have an orchestra as a part of its organization. Considerable development in this direction has already taken place in some schools, especially in one or two of the large public schools where boys stay usually till the age of 18, but valuable work can be done in a school orchestra even where scholars usually leave at the age of 15 or 16. A room, a piano, and some enthusiasm are the first necessities.

The foundation of a school orchestra will be stringed instruments. Quite good violins for beginners are purchasable, with complete outfit, for a sum round about 35*s*. The expense of tuition is lessened by the learners in the early stages being taken together in a class. If such violin classes are started in junior elementary schools senior schools will reap the benefit. The first step to be taken in forming a school orchestra would be to ascertain the number of stringed instrument players as a basis. If there are six violin players of some capacity, a start can be made. Other learners will join up later on. A pianist also is necessary. These are usually obtainable in numbers in a school, especially where there are girls. Unfortunately not more than two are employable at the same time in the orchestra.

If these conditions do not exist, the only remaining thing is to start one or more violin classes, for which naturally a suitable teacher must be found. A small fee for each lesson is usually charged, which the authority might be asked to supplement if the fees do not provide adequate remuneration. Something of an elementary nature can be done with piano and violins in two parts. Augener's publish two suites by St. George arranged for piano and strings which are quite effective even without the viola and cello. Augener's also publish some arrangements of classical and other pieces for three violins and piano.

Of the stringed instruments the viola is usually a difficulty, probably because it is not generally a solo instrument. But there are always interesting parts for it in chamber music, quartets, quintets, &c., and there are excellent solos obtainable with piano. A good violin player will learn the viola with assiduous practice in a few weeks. It means learning the alto clef, and getting accustomed to a slightly wider stop. The school should purchase an instrument. The cello is generally more attractive, and there should not be much difficulty in persuading one or two pupils to attempt it. The initial expense of an instrument is much greater than that of a violin or viola. The school should own at least one instrument, as it should also a double bass. In several cases members of the staff have taken up one or other of these latter three instruments, and there is an additional advantage in this as they do not desert the school after a year or two and leave a gap.

For wind instruments also one would generally have to rely on the staff, although a great deal of even symphonic work can be done and appreciated with strings and piano. In addition to other difficulties wind instruments that can be relied on to play in tune are expensive. Second-hand instruments are often of the old high pitch. One or two wind instruments of differing pitch will bring disaster to an orchestra. As the low or standard pitch has been adopted only recently in this country, a number of high-pitch instruments are for sale, and amateurs often get hold of an excellent instrument in this way; but if the low pitch is adopted in a school, as it should be for the sake of the singers, and the piano tuned to this, high-pitch wind instruments must be barred. A flute or clarinet can be flattened, but then their higher octaves are untuneful. An oboe can only be altered to a very slight degree and then mainly by the blowing. A school should aim at possessing, at any rate, a flute and a clarinet of low pitch and loan them to volunteers who may later purchase an instrument of their own.

Tympani and one or more brass instruments such as the trumpet and horn will be left for later development. A school orchestra is better without wind instruments unless they are played well. Satisfactory and even inspiring work can be done with a piano and strings.

Nearly all the well-known classical works can be obtained in arrangements for piano duet, and if two piano players are available, which is usual, such an arrangement is preferable, as it enlists an additional member of the school orchestra, the arrangement is usually simpler, and at the same time fuller, in the absence of wind instruments. The parts of the instruments that are present can be crossed out of the piano part if desired, thus leaving it to fill in the parts of the missing instruments if works for full orchestra are attempted. Many special arrangements, however, of orchestral works are to be met with for piano with a small body of instruments, mainly strings. Such are the Polychordia series published by Stainer & Bell, which start at the beginner's stage, and the Haus-Musik numbers published by Breitkopf & Härtel of Leipzig and 125 Shaftesbury Avenue, London. This latter series consists of classical works arranged for piano and a small orchestra. A fully graduated list of pieces suitable for school orchestras can be obtained from Mr. J. C. McLean, Sec. Nat. Co. of Music, Law Courts, Cardiff.

The organizer of a school orchestra should contemplate a course of five or six years for its establishment, and during that time he must expect discouragements and difficulties, but there will be the satisfaction of overcoming these. The active sympathy of the Head is essential, and the battle would be won if he could be induced to enlist. Conducting in the practices is not necessary. The organizer would be doing better work in playing an instrument, preferably the piano or first violin. The second violins should not be merely the weaker players. At least one good player should be among them to lead, that is one who can be relied on to take up the part after rests and to play decisively difficult passages, especially those that are rhythmically difficult from syncopation, &c.

If there is a specialist music master in the school, he should receive a certain sum for the organization and direction of the orchestra. When once there is a tradition of a few years behind it a school orchestra is likely to have an assured and a permanent position among a school's institutions, although provision of recruits must always be seen to as far as possible by the fostering of violin classes or any other means. When thus established it will do its full share of enriching the school life.

CHAPTER VIII

Art of Listening

Vocal and instrumental music have been considered. There remains this third branch which should not be neglected, as it represents the relation of the great majority of people to the other two branches. In its application to instrumental works it means the comprehension and appreciation of the principles of form and structure of the larger works such as sonatas and symphonies, in which the masters have enshrined their noblest thoughts and aspirations.

Sir Henry Hadow speaks of one lesson a week in this branch, and another in theory and practice. The latter, however, must predominate, certainly in the first two years of a senior school. But a certain amount of time per week should be spent in listening, even if limited to five minutes. The means will be principally the gramophone and wireless. Every school will eventually without doubt include these two items as a part of its essential equipment. The B.B.C. provides a series of weekly lessons and concerts. The former are divided into lessons for (*a*) juniors, (*b*) seniors, but the concerts, if the time can be made suitable, will be valuable to everybody, including the staff. The gramophone, now brought to a wonderful degree of perfection, will, however, be given priority. Chorus reproduction is still the least satisfactory, but instrumental records of solos as well as of concerted music reproduce original performances very faithfully, and the interpretation of the world's masterpieces by eminent artists can now be brought into a classroom, and if wisely used should have an enormous influence on the taste of the rising generation.

To serve as a background, a class would be expected gradually to acquire in its four years' course, for the quickening of their comprehension and enjoyment of instrumental masterpieces, the bare outline of something of the following nature. Suites of dance tunes as exemplified by Bach and Handel and their contemporaries are the earliest adventures. With the perfecting of instruments, especially the stringed family (Stradivarius was a contemporary of Bach and Handel), these suites developed into instrumental works of three or four movements, and the principle emerged victorious that these must be written round melodies. Such works are variously called symphonies, sonatas, quartets, trios, &c. Haydn and Mozart are the founders of this sonata form, and Beethoven (born in the same year as Wordsworth, 1770) developed it to its fullest extent. The usual movements are:—(*a*) a moderately quick movement, often following a slow introduction, (*b*) a slow movement based on a song-like theme, (*c*) a minuet or, since Beethoven, scherzo, (*d*) finale, usually very quick, of a light-hearted nature. The first movement is almost invariably the fullest of thought, and is built on two main contrasted themes. The last movement either follows in a lighter form the structure of the first, or, as a rondo, is based on one main theme, which returns after each of two or three subsidiary ones.

Modern composers strive to vary the sonata form by writing " fantasies ", or " rhapsodies ", or " symphonic poems " descriptive of the life of an individual or a more abstract subject. This is of the nature of programme music, and its merits will always be disputed. Wagner, the greatest composer since Beethoven, confined himself almost entirely to opera, and his music is thus altogether programme music. He has in fact labelled almost all his own melodies. In our own days one of the greatest works, if not the greatest, is the *Dream of Gerontius*, by an Englishman, Sir Edward Elgar. The *Dream* is programme music in its highest form, being spiritual as well as pictorial

Lessons to realize this should be given in extremely small doses, and always accompanying a gramophone record or the performance of a movement in some other way. They should never outrun very far the knowledge already possessed by the class or strain its interest. The class also, wherever possible, should take an active part. For example, when the first movement of a symphony, quartet, or sonata is approached, the introduction might be simply: " This movement is built up on two melodies; here they are ". They are then played and the class sings them in a suitable key. After hearing the movement once or twice, some discussion may be held with the class as to the character of the two themes or subjects, the contrast between them, the progress from one to the other, the recapitulation, the coda or completion, &c., and questions invited. Such a process will only develop very gradually, and principally in the later years. At the same time many records will be played without comment, or only the slightest. As an example, before hearing the overture to the *Midsummer-Night's Dream*, mention would be made of the fairies dancing through the air, Bottom the donkey braying, and at the end sleep prevailing. In the earlier years the best pieces are those which are strongly rhythmical. Illustrations of the lessons given in the class should also be sought for and discussed.

Of vocal items the selections should be limited to records of outstanding artists. Those of Gervase Elwes and Elena Gerhardt are a pure delight, and on the highest plane of art. Quilter's *Blow, blow thou winter wind* by the former, and Schumann's *Der Nussbaum* by the latter are inspiring. In the case of a song in a foreign language, a translation, or the subject-matter of the words, should be supplied. There are other living singers who have made some first-class records Singers with a pronounced wobble (vibrato), or who use the portamento excessively, should be avoided. Operatic excerpts are of doubtful value.

The field of selection in instrumental music is tremendously wide, and every teacher will make his or her own choice. When a library has been formed, some plan such as the following might be used for the different classes so that there may be interest and progression in the listening period:

First Year (11+).—Dance movements, marches, scherzi, and lighter overtures: instrumental solos.

Second Year.—Single movements from chamber music and symphonies· short orchestral works and instrumental solos.

Third Year and onwards.—Complete sonatas or symphonies taken by movements at different times. Overtures. Orchestral works and choruses.

CHAPTER IX

Additional Stimuli

School concerts, that is concerts in which the school forms the audience and supplies as well some of the programme, should be held as often as there is good material available for about half an hour's programme. If there are friends of the school with artistic talent they should be used. Combined singing would also constitute one or two items. A school committee should help to draw up the programme. Such performances will help materially to quicken the general interest, and to make all the scholars feel the importance of music in the school life.

In Wales, St. David's Day, 1st March, is given up almost universally to a school Eisteddfod, or a series of competitions in music, literature, &c. Music naturally plays by far the most important part. Competitions take place in choir singing, trios, duets, instrumental and vocal solos, sight-singing and composition. The experience is that, providing there are no money prizes, that any prizes given are of small value, or that there are none at all, the rivalry thus induced spurs a large number to special and healthy effort, and that means to individual development of powers often otherwise latent. Similar events take place no doubt in some English and Scottish schools, but there is an advantage in having a day set apart in which intellectual and spiritual exercises and contests are considered as the order of the Day. St. George's Day in England and St. Andrew's in Scotland might be thus set apart. On such a day and on such occasions, when for a short period music is the dominating influence and fills the atmosphere, and when the boys and girls in healthy rivalry are pacing one another on to perfection, forgetting the ordinary school routine and discipline, the pulse of the musical life of the school can be felt, hearts and minds are awakened, and an impetus is given to aspirations in all directions under the kindling influence of harmony.

The district musical festivals in which many schools take part would be more helpful to the music of the whole school if supplemented or preceded, as above suggested, by a purely school festival.

For a vigorous musical life and growth it is necessary to create and develop a musical atmosphere in a school, and every means possible should be taken with this end in view. There should be a musical function, either internal or embracing external elements, at least once a term, to which the whole school would look forward with interest and enthusiasm. If this atmosphere is established, it will have a real influence on all the varied interests and pursuits of the school, inasmuch as it kindles and nourishes the sense of beauty in the young, and this has its influence on the whole of the activities of the mind and spirit. This is real education. Greece by pursuing such an ideal has influenced the thought of the whole world. England through its poetry and drama, Germany through its music, have done something of the same nature.

It is possible that our country may have something to bequeath to and therewith enrich the rest of the world, in the realm of music. It rests with the teachers of the subject, who, if they rise to their opportunities, will earn their name, the noblest in any language.

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